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CONSUMER NEEDS IN ECONOMIC STABILITY

AN admirable report on "The Transition from War to Peace"* prepared by the Delegation on Economic Depressions, of which Sir Frederick Phillips is chairman, has recently been issued by the League of Nations. Although it has received singularly little notice officially, it provides the essential background in the discussions on employment policy which have been stimulated by the Beveridge Report, the Unilever paper, the Nuffield College statement and other publications on that subject; further, it underlines the recommendations already advanced, that we must think out our policies and measures well in advance, and that we should utilize whatever is possible among the international agencies established to further co-operation during the War. No previous official document has set out so clearly the relations between immediate post-war measures, such as international relief, the removal of industrial controls, rationing and the lowering of taxation, and the larger economic policies for the maintenance of full employment and economic stability.

The report opens with the warning that the War is creating economic changes and upheavals which will intensify greatly the forces leading to instability in the post-war world. Policies must be devised in advance in order that the risks of depression and unemployment may be mitigated, and in particular every effort should be made to think out in advance the methods by which as smooth a transition as possible from war- to peace-economy can be effected. If the economic and social objectives of the United Nations are to be fulfilled, means must be devised for maintaining in time of peace the high levels of production and employment achieved in war-time. Independent action by each country for the achievement of full employment and economic stability would inevitably defeat itself. National policies must be co-ordinated, and this pre-supposes the firm establishment of political security and economic policies no longer conditioned by the fear of war.

To the condition of political security must be added that of popular understanding, and this report makes a notable contribution to the comprehension by the rank and file of the people of how much is at stake. Such understanding is an essential complement to the high degree of statesmanship and courage on the part of those responsible for post-war policy which will be required to resist the spurious 'realism', ignoring the effects of national policies on the interests of other countries, which is already discernible in some of the reconstruction reports which have appeared in Great Britain. We cannot, it is true, foresee the conditions that will obtain at the termination of hostilities, but some of the factors, such as the growth of engineering and machine tool industries in various parts of the world, the acceleration of industrialization in certain agricultural areas,

* The Transition from War to Peace. Report of the Delegation on Economic Depressions. Part 1. (League of Nations. C.6.*N*.6. 1943. II. A.) Pp. 118. (London : George Allen and Unwin, Ltd.) 4*s*. 6*d*. net.

shifts in population, etc., are known; it is the broad lines of policy which, as in domestic reconstruction, demand immediate attention.

Dealing with the objectives of economic policy, the report suggests that first we should think in terms of consumers' needs and then in terms of our mechanical, scientific and human power to satisfy those needs, thus reversing a marked and dangerous tendency of modern publicity policy in industry to which attention was directed by Mr. Alderton Pink in his "Social Reconstruction" and by Mr. Samuel Courtauld in his paper on "Government and Industry". The first objective should be to assure that the fullest possible use is made of the resources of production, human and material, of the skill and enterprise of the individual, and of available scientific discoveries and inventions, so as to attain and maintain in all countries a stable economy and rising standard of living. This was the note struck by Mr. Lyttelton in his speech at Oxford on July 23 when, urging imagination and audacity over the whole field of British industry, he said that it is towards the creation of demand and to the use of inventions that the economic thought of our specialists should be directed.

The second objective should be to ensure that no man or woman able and willing to work should be unable to obtain employment for periods of time longer than is needed to transfer from one occupation to another, or to acquire a new skill. Next, the provision of goods and services to meet the essential physiological needs of all classes of the population in food, clothing, house-room and medical care should be a prime consideration in the use of productive resources. Further, the risk to the individual resulting from interruption or reduction of earning power should be spread over the whole of society; and the liberty of each individual to choose his own occupation should be respected and promoted by equal educational opportunities. Lastly, by courageous international measures of reconstruction and development, the benefits of modern methods of production should be made available to all peoples.

The acceptance of these objectives, which reflect a general orientation of thought that is widely found to-day, should make it easier to avoid or mitigate economic depressions. They involve, moreover, no assumptions regarding the social-economic system or the degree of participation of the State in economic life that may be desired in different countries, other than the responsibility of governments for avoiding large-scale and protracted unemployment.

The second chapter of the report gives an analysis of the domestic issues in the transition from war to peace in countries like Great Britain and the United States, which demonstrates the imperative need for Government preparations in advance and decisions on policy before the War closes. The probable nature of post-war demand is first considered. To get the demobilized men back into employment will be the first concern and may not be too difficult. Production to satisfy consumers' wants, on the other hand, may present enormous difficulties if a runaway price boom and the subsequent collapse are to be averted. The report itself, with its lucid exposition of the reasons why measures taken to control prices and effect an equitable distribution of supplies, both to producer and consumer, should not be abandoned suddenly but relaxed gradually as shortages are overcome, makes an invaluable contribution to the wise publicity required to secure support for such a policy. Government orders and public works are bound to play an important part in facilitating or impeding a smooth transition, and the report repeatedly stresses the necessity for correct timing.

There are two major dangers. First, that projects indispensable for getting the whole national or international economic mechanism functioning again will not be ready, and secondly, that governments will hamper economic recovery by launching too many schemes or launching them at the wrong moment. Governments should endeavour to fill gaps in demand rather than to compete with the market, and the importance of fiscal policies which will encourage enterprise and of government schemes for teaching new skills to meet the new needs that will arise are also stressed. The case for continuance of the controls and for a general government plan over a period of five or ten years could scarcely be better put, and it is all the stronger for the insistence in the report on giving to the consumer all the freedom possible—and freedom from the vice of control for control's sake. No country, however, as the report observes, can hope to keep business active if central control and singleness of purpose are lacking.

No less lucid is the treatment of the international problems of transition in the following chapter. Here again the report insists on the necessity of allowing consumption to expand gradually and smoothly, and that relief and reconstruction should be considered as a single problem. Relief is the first step in reconstruction, and if it fails to reconstruct, it is ineffective charity. It should not only provide for physiological needs, but also enable those requiring help to restore their own economy. Effective programmes of relief and reconstruction will depend on the availability of the essential foodstuffs, raw materials and other goods, and therefore upon the equitable distribution of supplies while supplies are short.

For this reason an international understanding is advocated regarding changes in rations and in the maximum prices to be fixed for goods in the early post-war period. Again, to prevent a scramble for raw products, tonnage, etc., machinery for the purchase and international distribution of such products and for the joint control of tonnage should be continued or instituted, so long as serious shortages persist. As supplies of raw materials become more plentiful, this machinery might be used to stabilize prices by co-ordinating supply and demand and by the creation of buffer stocks. International funds will also be required, for example, in the first instance, to meet the demand for food, raw materials, and certain finished goods, to feed and clothe the populations and gradually to restart production in the stricken areas, as well as for capital to repair the physical damage and make good the wear and tear suffered during the War. The availability of such funds will depend on the relaxation of exchange controls and

the possibilities of effecting multilateral clearing and conducting multilateral trade.

In this connexion the report refers to the proposals of the British Treasury and those of the United States to establish some form of international clearing or equalization fund. The control of inflation, the principles on which long-term lending should be based, and the dangers which may be encountered in an effort to realize the general objectives of commercial policy already laid down in the Atlantic Charter and in Article VII of the Mutual Aid agreements, are also discussed and analysed. In conclusion, the report emphasizes the necessity of finding means of co-ordinating the policies of the various international organs required, and, secondly, that economic policy must be correlated with political.

The great value of the report is first in its clear statement of the long-term objectives on which it is based, and it is encouraging to find that those objectives are already accepted in many quarters in Great Britain—for example, in the report on reconstruction issued last year by the Federation of British Industries. In contrast to the timidity of the Federation's report, however, the present report is based on a belief that courage and enterprise on the part of governments and individuals in making prompt adjustments to changing requirements can secure a prosperous equilibrium. That belief also inspires the Planning broadsheet "Employment for All", the Unilever paper on unemployment, and the Nuffield College statement on "Employment Policy and the Organization of Industry after the War".*

The PEP broadsheet in question emphasizes the importance of agreement between the leading nations on economic policy and the special responsibility of the United States and Britain to put their house in order. If they establish full employment and a high demand for imports, they will go a long way towards increasing prosperity in the world as a whole. The transition from war to peace is seen, as in the League of Nations report, as a gradual process, and the broadsheet attempts, first, to outline the guiding principles of a policy for full employment, and secondly, to indicate the operation of those principles in the post-war years.

The immediate cause of cyclical and long-term employment is due, according to the PEP broadsheet, to a decline in demand for capital goods, due in turn to a low demand for consumption goods. Under-investment is largely the result of under-consumption, and the first attack on unemployment is a policy to increase consumption. In this attack the social security system outlined in the Beveridge Report is an important factor, and redistribution of income from higher to lower income groups is also advocated as a means of increasing the spending of the community as a whole.

The second line of attack is investment policy, and here the broadsheet advocates the use of public works as a powerful instrument of business stabilization. The extension of the sphere of public investment is also recommended, and such investment would be determined not by ordinary commercial profit but by social requirements and by social standards such as nutrition, housing and clothing, which could be scientifically ascertained. It is urged that by limiting the sphere of private investment and controlling much of the remainder, the impact on general economic activity of the fluctuations in private investment, which are the main cause of cyclical fluctuations, would be reduced. It is believed that the raising of consumption through progressive redistribution of income and the stabilization of a large part of investment activity would in themselves have a sufficient stabilizing influence on the remaining sphere of private investment.

The proposals of the Nuffield College statement are somewhat different. It recognizes the excellent results to be looked for from a system of social security, and that measures to stimulate investment are indispensable to secure full employment. While, however, it holds that public works, including works undertaken directly at the orders of public bodies and works undertaken by private agencies or contractors as a result of public encouragement, constitute a valuable means of maintaining the level of investment, the cost of such investment should not be met out of higher taxation, as this will react adversely on consuming power. In times of economic difficulty the burden of taxation should be lowered rather than increased.

To enable the State to plan and stimulate investment over a system of priorities according to social needs, it advocates a general extension of long-term economic planning and an extension of the public corporation principle to cover a number of industries and services which are among the largest consumers of capital goods, especially the essential transport services and the main public utilities, both for extensions and replacements. Building, in particular, is a key industry in this connexion, and State policy should be directed towards securing a high and increasing level of output during the period immediately after the War, and thereafter towards ensuring a reasonable degree of stability, in terms of a long-period programme of building, to be accelerated or retarded as part of the deliberate policy of maintaining the level of real investment.

For the execution of this policy, the statement makes one proposal which has already been encountered in the Unilever paper. First, a new method of presenting the national accounts, in which capital expenditure, which would not require to be covered by taxation, is presented to Parliament in a capital budget, embodying plans of economic development framed to ensure a progressive rise in standards of living and amenity. Such a policy of a national stock-taking, which involves the creation of a more efficient and better co-ordinated statistical service than Great Britain has hitherto possessed and the establishment of a permanent Control Statistical Office, adequately staffed for prompt service, is an integral part of this proposal. Secondly, it suggests the establishment of a National Development Board to which should be entrusted the control of funds

* Employment Policy and Organization of Industry after the War: A Statement. Nuffield College. (London: Oxford University Press, 1943.) 2s. net.

available for public investment, as well as the functions now performed by the National Debt Commissioners, the work relating to local loans, the functions of the Public Works Loans Board, and the supervision of all State investments in productive enterprise, together with the licensing of capital issues or other forms of capital expenditure which might be made subject to public control. The Development Board, as well as economic planning generally, including the location of industry, would come under a new Minister for National Development.

The Unilever paper, it will be recalled, considers that a general planning board would be almost helpless in regard to fostering progress and would be apt to discourage rather than stimulate ventures. Again, in contrast to the PEP broadsheet, the Unilever paper holds that under-consumption is in reality a consequence of the interruption of productive activity caused by the trade-cycle and therefore a symptom rather than a cause of depression. Social insurance schemes can make an important contribution to the solution of the problem of poverty, but the real cause of unemployment is irregularity of capital investment, and the essential measures required are government measures which should be planned well in advance and ready for immediate application. Industrial and international measures are indeed also required, and the close similarity between those detailed in the Unilever paper and those in the League of Nations report is encouraging evidence that there is some consensus of opinion as to the measures to be taken.

No one reading the three British contributions on this subject of full employment can doubt that support will be forthcoming in Great Britain for bold planning, or that its industrial leaders will be lacking in initiative and enterprise, or fail to show the flexibility and efficiency required. Even where there are differences of opinion as to primary causes, the action recommended is essentially similar, differing slightly in the relative emphasis on particular points. The importance of correct timing is already appreciated, and in every statement or report we find condemnation of the delay in implementing the proposals of the Barlow Report and in finding a solution of the problems of compensation and betterment studied by the Uthwatt Committee.

On the need for Government decision on policy and for executive action, these reports and papers, like many others, leave no room for doubt. In building and physical reconstruction, in town and country planning, in agriculture, in matters of compensation and betterment, of local government and regionalism, there are confusion and a growing sense of frustration due to the Government's failure to take decisions and announce its policy. Ministerial distinctions between delay and consumption of time increase the scepticism and cynicism which are a disheartening accompaniment of our progress in the War. They are unworthy of the leadership which has brought this nation through the dark days of 1940 and inspired the strenuous exertions, sacrifices and achievements which are bringing us within sight of our goal. No demands made on the Government for the conduct of the War can alter the fact that primarily on them does it depend whether we are to become masters rather than servants of the forces that make for change, and whether we succeed in "the great tasks of rebuilding, of securing the advance of ideas and not letting it be swept back by mere tides of lassitude, exhaustion or reaction—the reconstruction and consolidation of our country in the gains which we shall have made during this hard and long trial". Thus spoke the Prime Minister, and his words must be matched quickly by decision or delegation.

THE ADVANCE OF BIOCHEMISTRY

Advances in Enzymology and Related Subjects
Edited by F. F. Nord and C. H. Werkman.
Vol. 1. Pp. x+433. (New York: Interscience Publishers, Inc.; London: H. K. Lewis and Co. Ltd., 1941.) 5.50 dollars; 33*s*. net.
Vol. 2. Pp. viii+374. (New York: Interscience Publishers, Inc.; London: Imperia Book Co. Ltd., 1942.) 5.50 dollars.
Vol. 3. Pp. viii+408. (New York: Interscience Publishers, Inc., 1943.) 5.50 dollars.

"ADVANCES in Enzymology" is the successor of "Ergebnisse der Enzymforschung", which appeared first in 1932 and ceased to exist after its eighth annual publication in 1939. During this period the "Ergebnisse" achieved a high reputation for the authoritativeness of its articles, which covered most fields of biological chemistry. It was consulted by research workers, teachers and students, who found it a ready means of keeping abreast of a complicated and diffuse literature. Its complete disappearance would have meant a great loss. Fortunately, it has been born again under the title "Advances in Enzymology": edited by Nord and Werkman, and published in the United States. The first three volumes of this annual publication have now appeared and cover the years 1941–43. The high scientific quality of the articles that was associated with the "Ergebnisse" is maintained, and although there has been obvious restriction in choice of authors (due to war conditions), the matter published is instructive, critically written, and embodies many of the most recent developments in biochemistry.

No major advance in the study of enzymes or in our knowledge of the working of the living cell can be imagined taking place without due regard being paid to the composition of proteins, which are known to form the basic structure of enzymes. "Advances in Enzymology" commences appropriately, therefore, with an article (vol. 1) on protein structure by Bull. He deals in an interesting and stimulating manner with the work of Bergmann, Astbury, and Wrinch, regards with extreme conservatism the classification of proteins on a basis of molecular weights, and discusses critically the Bergmann theory that all proteins are made up of whole-number multiples of a definite number of residues. Astbury, whose X-ray analyses of proteins have done so much to advance our knowledge of their structures, has in a later article (vol. 3) considered the propositions of Bergmann and Niemann that (1) the numbers of the different kinds of residues, and also the total number of residues, in the molecule, are always of the form $2^n 3^m$ where n and m

are positive integers or zero; and (2) the residues of any one kind occur at a regular periodic interval along the polypeptide chain. He shows that the best evidence for the validity of the $2^n 3^m$ rule comes from the analytical work of Chibnall on the composition of edestin, though the latter's results with egg albumin do not support the rule so clearly. He concludes from a variety of evidence that the rule operates in the building of the constituent parts of proteins, and sometimes in the building of the whole protein molecules. Astbury reviews the chemical and X-ray evidence bearing on the structure of fibrous proteins (silk fibroin and the keratin-myosin group) and of a number of other proteins, and proposes a model based on the principle that, in general, polar or non-polar side-chains occur alternately along the polypeptide chain.

The fact that plant viruses are nucleoproteins capable of self-multiplication throws into prominence the fact that chromosomes are largely composed of nucleoprotein, and suggests the possibility that the nucleoprotein of chromosomes may also be capable of self-multiplication. Mirsky (vol. 3) ably presents the beginnings that have been made in biochemical investigation of chromosomes and of nucleoproteins generally. He discusses the nucleoproteins of nucleus and cytoplasm, and their relationships to virus proteins. Those of the latter which have been isolated are ribose nucleoproteins—differing thus from the desoxyribose nucleoproteins of the cell nucleus—and are more comparable with the self-duplicating plastids, the chloroplasts, in the cytoplasm of many plants. The great accumulation of desoxyribose nucleoprotein in the chromosome suggests that these proteins are identical with the genes, or are intimately related to the genes. Mirsky refers to the view of Caspersson that the presence of high concentrations of ribose nucleic acid in the cytoplasm during growth is in some way concerned with protein synthesis.

It is obvious that the bearing of nucleoproteins on catalytic processes in the living cell is of the greatest importance for our understanding of cell mechanisms. This is further emphasized in the recent findings concerning the mechanism of enzyme action.

It is now known that many oxidizing systems in the cell require the participation of special proteins and also of defined chemical groupings (sometimes called prosthetic groups, sometimes co-enzymes). The complex of protein and grouping forms an enzyme system. Cozymase—one of the best known of these groupings—is a nicotinamide-adenine-dinucleotide; it can combine with various specific proteins to produce a variety of enzyme systems, each having separate and specific catalytic powers in the oxidation of substances important in cell metabolism. Flavin-adenine-dinucleotide is another such grouping having associations with specific proteins concerned with oxidative processes. Such matters as these are discussed by Green (vol. 1), who deals with the influence of so-called 'trace' substances on enzyme activity. He refers also to the co-enzymic roles of diphosphothiamine, copper, and zinc, and to the possibility that many substances of high physiological activity (insulin, thyroxin, and other hormones) may play a part in the body similar to that of the coenzymes.

The specificity of action of an enzyme system depends not only upon the chemical nature of the co-enzyme but also upon the constitution of its specific protein. There are large groups of enzymes, however (for example, the lipases, sulphatases and proteinases) which are not known to be associated with co-enzymes; their properties must be deemed at present to be determined solely by the configuration of groupings embodied in the proteins themselves.

The general problems of the classification and the specificity of action of proteolytic enzymes are dealt with by Bergmann (vol. 2), and by Bergmann and Fruton (vol. 1), while peptidases receive attention from Johnson and Berger (vol. 2). Bergmann clarifies the somewhat complicated picture which has arisen concerning the specificities of action of the whole class of proteinases and peptidases. He points out that these enzymes may act in two different ways. One type of reaction results by the specific action of a single enzyme on a single peptide bond, while the other type consists of a sequence of coupled reactions involving several peptide bonds and several enzymes. It is the latter type which must be dominant in protein synthesis—if indeed the thesis is correct that protein building in the cell is the result of proteolytic enzyme activity. Johnson and Berger review critically our present meagre knowledge of peptidase systems and point out that "too few current papers take sufficient cognisance of our complete ignorance of the enzymatic constitution of most peptidase systems".

Descriptions of the chemical nature and modes of action of certain enzymes important in oxidative processes in the cell, namely, catalase, diamine oxidase, and verdoperoxidase, are given by Sumner (vol. 1), Zeller (vol. 2), and Agner (vol. 3), respectively.

The oxidative enzyme systems playing a part in tea fermentation form the subject of an interesting article by Houghton-Roberts (vol. 2). He shows that the chemical changes taking place after the rolling of tea leaf—when something like 95 per cent of the tannins present become oxidized—can be explained on the basis that mechanical damage interferes with the normal oxido-reduction equilibrium between the *o*-quinones, produced by tannin oxidation, and carbohydrates in the leaf. As a result of this interference, which leads possibly to dilution of the co-enzymes involved, the *o*-quinones are rapidly condensed to complex tannins.

Enzyme systems in the plant, especially those leading to sucrose formation, are dealt with by Kurssanov (vol. 1), while enzyme systems in tumours form the subject of an article by Greenstein (vol. 3). Greenstein concludes that no simple generalization will cover enzymic behaviour of all groups, or even of any one group, of tumours. The direction and magnitude of the changes taking place when a neoplasm develops depend on the species of animal and the strain in any given species, as well as on the kind of tumour. A clear picture of what takes place can only be obtained by systematic investigation of the many enzyme systems present.

The study of the effects of temperature on enzyme kinetics is reviewed by Sizer (vol. 3). Van Slyke (vol. 2) describes methods in vogue for the study of the kinetics of hydrolytic enzymes such as urease and arginase, and gives a quantitative formulation of the kinetics of the two-phase reaction.

Turning from the study of enzymes to consideration of metabolic systems, excellent articles are to be found on the subjects of photosynthesis (Van Niel, vol. 1; and Frank and Gaffron, vol. 1); of the breakdown of cellulose by micro-organisms (Norman and Fuller, vol. 2); and of the role of micro-organisms in wine-making (Cruess, vol. 3). Van Niel deals only

with the phenomena of bacterial photosynthesis. He describes (together with other matters) the metabolism of the green and purple bacteria, and interprets the events taking place on the basis of a photosynthetic carbon dioxide reduction depending on the simultaneous oxidation of special hydrogen donators. The facts and interpretations of photosynthesis in both plants and bacteria are fully considered by Frank and Gaffron, who deal with the thesis that the anaerobic type of photosynthesis is the same in *all* cells, but is supplemented in green plants by the capacity of liberating gaseous oxygen.

Norman and Fuller's article on cellulose decomposition is of particular value just now when knowledge is wanted of the details of the breakdown of straw and plant residues in composts, in soil, and in the animal digestive system. These authors show that important aspects of the breakdown of cellulose can only be investigated by the use of mixed as well as of pure cultures of organisms.

Advances in knowledge of carbohydrate metabolism are reviewed by Barron (vol. 3) and by Krebs (vol. 3). Krebs considers in detail the oxidative changes undergone by substances concerned in carbohydrate breakdown in the living cell. He examines the various schemes and cycles of operations in which these substances may be involved. Barron's article deals mostly with the steps involved in carbohydrate fermentations. It indicates the vital importance of phosphorylations and of the key position taken by pyruvic acid, "the hub towards which comes fermentation, from whence starts oxidation". The importance of the phosphate bond in the changes occurring in the living cell receives due recognition in an interesting article by Lipmann (vol. 1), who describes, in the light of his concept of the energy-rich phosphate bond, many of the metabolic reactions involving phosphorylation and phosphate transfer.

One of the most important advances made recently is the demonstration by Wood and Werkman of the heterotrophic assimilation of carbon dioxide. These authors describe (vol. 2) the phenomenon in detail, and also describe the parts played by carbon dioxide in the metabolism of bacteria and animal tissues.

Advances in biochemistry necessarily involve increased knowledge of the constitution and properties of vitamins and hormones. Biotin receives attention from Hofmann (vol. 3); the elucidation of its structure by du Vigneaud and his colleagues is described, as are its occurrences in free and bound forms, and its role in animal nutrition. Biotin is a most potent growth factor; it is now receiving attention as a possible factor in the development of tumours. Another important growth factor is pantothenic acid, the structure and properties of which are described in vol. 3 by R. J. Williams, who has done so much to elucidate the properties of this vitamin. Deficiency of pantothenic acid in the diet leads to diverse pathological changes, among which are dermatitis and a depigmentation of hair. In fact, pantothenic acid is receiving increasing attention as an anti-grey hair factor. The chemistry and physiology of vitamin K—a 2-methyl-1 : 4-naphthoquinone derivative which is connected in some manner with enzymes involved in blood coagulation, and is sometimes referred to as an antihæmorrhagic factor—are described by Dam (vol. 2). The important adrenal cortical hormones (corticosterone, dehydrocorticosterone, and androsterone) are dealt with by Pfiffner (vol. 2).

Other articles on the structure of glycogen, the respiration of Aspergillus, digestion in the lower vertebrates, and on some properties of bacteriophage, complete a valuable series of reviews, to the continuance of which all biochemists will look forward with interest.

J. H. QUASTEL.

SOIL AND PLANT ANALYSIS

Soil and Plant Analysis

A Laboratory Manual of Methods for the Examination of Soils and the Determination of the Inorganic Constituents of Plants. By Dr. C. S. Piper. (A Monograph from the Waite Agricultural Research Institute.) Pp. xiv+368. (Adelaide: University of Adelaide, 1942.) 15s.

BOOKS on methods of analysis can be divided into two classes, one of which is the 'collected methods' type. Here each chapter or section of the book is devoted to a specific analysis or group of related analyses, and gives the working details of all or nearly all the existing methods. Such books are not only very useful and convenient but also are a necessity for those analysts to whom the original papers in the literature are not easily accessible. It is, however, the other class of book that the analyst most appreciates, namely, the book in which he is not bewildered by an array of methods but is presented with a selection recommended from considerable experience. Dr. Piper has compiled his book along these lines, and all the methods, with a very few exceptions, are those in use at the Waite Agricultural Research Institute. Concise, and more important still, precise working details are given with ample explanation and a wealth of guidance and help.

In the first section of the book, dealing with soils, the methods, both physical and chemical, are those that are useful in soil survey work and in the study of long-term factors affecting soil fertility. The very simple and rapid methods for estimating fertilizer requirements of soils have not been included, since none has been generally acceptable; and in the opinion of the author such tests are unlikely to simulate the conditions in the soil during the growth of the plant. In the second section of the book, Dr. Piper presents methods for the determination of the inorganic constituents of plants which form a logical alternative to rapid soil methods and are a more reliable approach to the availability of soil minerals, especially those supplying trace elements. Plant analysis is of supreme importance in fertilizer investigations and in studies of animal nutrition problems.

Full treatment is given to the subjects of hydrogen-ion concentration, mechanical analysis, single-value soil constants and exchangeable ions. The methods for the determination of the sesqui-oxides, alkaline earths and alkalis contain just those essential details without which the analyst may find himself in difficulties. The chapter on wet- and dry-ashing is a valuable contribution. To those concerned with plant analysis and to many others the determination of the trace elements will perhaps appeal most of all. Here an organic reagent, dithizone, plays the leading part in the scheme of inorganic analysis. It is used with much success in separating most of the inorganic elements.

There can be no doubt that this book is an outstanding addition to those already written on this subject.

A Family of Devon

Their Homes, Travels and Occupations. By Dr. Vaughan Cornish. Pp. viii+56+10 plates. (St. Leonards-on-Sea: King Bros. and Potts, Ltd., 1942.) 1s. 6d.

DR. VAUGHAN CORNISH is a geographer who, in addition to his scientific studies of waves on sea and land and kindred geophysical phenomena, has devoted particular attention to the æsthetic aspects of natural scenery. He has long taken an active part in preserving the amenities of rural England and is the donor of South Combe Farm on Sidmouth Cliffs as an open space in perpetuity.

At the beginning of last century, George Cornish, who had been an officer in the Royal Marines and served in India as an A.D.C. to Sir John Shore, purchased an estate at Salcombe Regis, now included in the Sidmouth Urban District, and there founded the Sidmouth branch of the family. Dr. Vaughan Cornish is one of his descendants, and in this book he traces associations of members of the whole ancestral group with the part of South Devon in which they had their homesteads. The book is, however, more than a genealogical record and presents a picture of the life of lesser country gentry farming their own lands from Tudor times to the present day.

Throughout this period the intellectual interests of one or another of the family have been influences for good in the history of England. So long ago as 1775, some letters from Dr. James Cornish, "On the Torpidity of Swallows and Martins", were published in the *Philosophical Transactions*. He was the first of the family to branch out into authorship, and a number of other members have worthily followed him in literary, artistic and scientific fields. On the natural history and country-life sides, C. J. Cornish, a master at St. Paul's School, was a brilliant writer on these subjects in the *Spectator* and other journals. He was a brother of Dr. Vaughan Cornish, whose wide outlook and acute vision have maintained the cultural tradition of the family which he represents so well.

Practical Emulsions

A Handbook of Emulsions, Emulsifiers and Methods of Formulating and Making Emulsions of Practical Value in Industry. By H. Bennett. Pp. x+462. (Brooklyn, N.Y.: The Chemical Publishing Co., Inc., 1943.) 5 dollars.

THE principal object of this book is to deal, in reasonably small compass, with emulsions for the practical worker. Concentrating upon the art of making and applying emulsions, it touches only lightly upon the theoretical aspects, and illustrates these main themes by reference to practical usage.

Rather more than half the book is devoted to emulsion formulæ and directions for formulation. The remainder, under the term "General", outlines such topics as emulsifying agents, types of emulsions and assessment of stability, general methods of preparation and types of equipment employed, together with the related topics of foams, dispersing and wetting agents, and demulsifying and defoaming agents. While much useful practical information is to be found in this part, it does give the very definite impression that emulsion practice is still carried on as an empirical art with very little guidance from an understanding of the basic factors involved. Since the theoretical aspects are touched upon, albeit only lightly, a brief but lucid exposition of modern advances would have been beneficial in enabling the practical worker to appreciate some of these more fundamental factors. In this connexion one is surprised to see the orientated wedge theory of emulsification given so much prominence. It is felt that this part could with advantage have been considerably reduced, leaving all theory to specialized treatises on the subject.

The second part, under the heading of "Formulas", gives an excellent idea of the multitudinous applications for emulsions: agricultural sprays, cutting oils, cosmetics, foods, lacquers, lubricants, paints, paper, waterproofing and so on. No less varied are the ingredients used. The emulsion technologist should find these recipes very useful.

The book is well printed and typographical mistakes are few.

A. E. ALEXANDER.

War-Time Food for Mother and Child

By Dr. Geoffrey Bourne. Pp. 78. (London, New York and Toronto: Oxford University Press, 1942.) 2s. 6d. net.

THE Minister of Food has shown his appreciation of the special needs of pregnant and nursing women and of growing children by the special allowances that he has made for these groups. However, these requirements are not so well realized by the general public. Anything that hammers in the fact that pregnant and nursing women and young children are the most vulnerable of our citizens is welcome. Dr. Bourne's book gives a clear explanation of the requirements of pregnancy; this is enlivened by information about the development of the fœtus not commonly found in books on nutrition. He might, perhaps, have brought out more clearly the fact, obvious but often overlooked, that the nursing woman has to supply all the constituents of her milk either from her food or from her own body. The extra needs during lactation are therefore more unquestionable than during pregnancy.

Dr. Bourne gives detailed advice about diets, suited to present conditions, from early pregnancy to school years. In some respects this is less satisfactory than the account of requirements and may be unrealistic. For example, as breakfast for a pregnant woman: "In place of orange or lemon juice eat black and red currants or drink infusions of hip and haws when they are available . . . . The water left, when boiling vegetables . . . can be flavoured with Marmite or meat extract and then make a pleasant drink. . . . After the vitamin C supplement a herring or kipper, if obtainable, may be eaten instead of an egg. . . ." How many people could get currants, during their short season, in the past two years? Why not tomatoes, which have a longer season and have been distributed widely if erratically? What proportion of breakfasts can supply egg or fish? The vegetable water would be kept from the previous day; how much ascorbic acid would it contain unless kept in a refrigerator? Such advice tends to undo the good done by the valuable exposition of special requirements. In the more general discussion of diet, Dr. Bourne does not bring out the special importance of green vegetables—the food of which we can get more than we could in peace-time.

With these criticisms the book can be recommended for the material that is not found in other books on nutrition.

SCIENCE IN WESTERN SZECHUAN

II. BIOLOGICAL AND SOCIAL SCIENCES

By Dr. JOSEPH NEEDHAM, F.R.S.
British Scientific Mission in China

IN the preceding article* something has been said of the state of physics and chemistry in the five universities at the great city of west Szechuan, Chengtu. On the whole, the biological work there is even more active. On the West China Union (Huahsi) University campus some excellent taxonomic and ecological work is being done. Thus Dr. Chang Ming-Chun of Huahsi specializes on gastropod systematics and embryology, while Dr. Liu Cheng-Chao of Yenching is a really outstanding authority on Asiatic Amphibia. His collections and data are astonishing, including torrent adaptations, strange breeding habits, etc., and many new species, such as *Vibrissaphora boringii*, a whiskered frog. There are great opportunities for experimental embryology here, which have so far not been taken advantage of. Dr. Liu himself goes on collecting expeditions in the Tibetan borderlands which involve real hardship and danger. For comparative physiology also there are great opportunities, for example, to work with the giant earthworms of the Mount Omei region, species of Pheretima, commonly up to 3 ft. long and at least 1 in. in diameter.

Parasitology has an eminent representative in Dr. Chang Kuei of Chilu, who has done remarkable work on a hookworm survey of the province, with the help of the Rockefeller Foundation. Infestation has a very close association with the maize and sweet potato pattern of cultivation rather than with the rice pattern. If pronounced, it leads to strange phenomena such as geophagia. Among the activities in the fine biological building on the Huahsi campus are also a service for the preparation of biological models in painted plaster for schools and universities, and of injected biological specimens. There is also an interesting project in domestic science under Dr. Peng Yuing-Hua, popularizing jam-making among the Chinese people in order to avoid the hitherto normal annual wastage of fruit. There is a strong school of plant pathology, economic insect pest survey, etc., under the direction of her husband, Dr. Ho Wen-Chun. They both studied in Iowa. Last, but not least, Dr. F. Dickinson's work on animal breeding, fruit-tree improvement, etc., has benefited the whole province and is known throughout China.

Plant pathology leads to reference to a sixth university not mentioned in the preceding article, namely, the provincial University of Szechuan, occupying its own new buildings on an unfinished campus some distance away from Huahsi University. Its strongest side is agricultural science, so that when the Szechuan Provincial Agricultural Experiment Station is also taken into account, the importance of Chengtu as an agricultural centre can be well seen. The plant pathologist at the Experiment Station is Dr. Ling Li, who has described mosaic disease in Cruciferæ, and has published many papers in such journals as *Phytopathology*. He recently collaborated with the Imperial mycologist from New Delhi, Dr. Watts Padwick, who visited China as a technical expert at the invitation of the Chinese Government. The authority on insect pests at Szechuan University is Dr. Tseng Shen, who is very active against tobacco diseases; he leads expeditions through the countryside, giving instruction to the peasants. The Agricultural Experiment Station actually operates an insecticide factory of considerable size, producing pyrethrum powder, copper carbonate and arsenate, etc., with very primitive but serviceable apparatus. In Dr. Liu Chwing-O, the University of Szechuan has an exceptionally eminent authority on wood-boring insects, especially the larvæ of longicorn beetles; she is in touch with the British Museum (Natural History) through the British Scientific Mission. Her work on coleopteran parasites of coleopteran wood-borers is of much interest.

Other departments, too, are worth a visit. At Szechuan Agricultural Experiment Station there is good work going on in crop improvement under the active Dr. Li Hsien-Wen, an associate of the well-known geneticist Dr. Beadle. Dr. Li produces new disease-resistant wheats for the Chengtu plain, but is also interested in cytoplasmic inheritance of variegation in Triticum, and the production of new species of Setaria by crossing. Dr. Li points out that a certain kind of barley, selected at the University of Nanking in 1937, was taken to the United States by Dr. Love, and proved to be so good that 'Wang barley' has by now far more than paid for all the expenses incurred by the United States in sending technical experts to China. Then at the University of Szechuan the botanical department is outstanding. Under Prof. Fang Wen-Pei, very extensive collections of west Chinese and central Asiatic plants have been made; and duplicates are available for exchange with Western collections. Prof. Fang has recently produced a most beautifully illustrated work "Icones Plantarum Omeiensis", which includes descriptions and pictures of new genera as well as many new species. Copies have been sent to Kew and other centres.

In sericulture (Prof. Wang Tao-Yung) the University of Szechuan is strong too; work is under way on comparative silk-gland histology, bacterial diseases of silkworms, survey of mulberry varieties, and physiology of the wild race. Thirty-eight pure lines and many hybrids are maintained in this laboratory. Here again, after the War, there would be great opportunities for a physico-chemical attack on the nature of the spinning process, that is, how the liquid gland contents become the spun fibre. The stranger is surprised to be told that from each cocoon 500 m. of silk fibre can be drawn. Since the old form of the Chinese character for Szechuan contains the radical for insect, Szechuanese sericulturists believe that sericulture originated in their province.

In horticulture also the Szechuanese have an ancient tradition, for this province is thought to have been the original home of the orange. The department at the University of Szechuan points with pride to the treatise of the Yuen dynasty (about A.D. 1200) by Han Yuen-Chih called the "Orange Record". Chinese horticulturists are looking to Britain's Food Investigation Board to give them advice about the erection of refrigeration plants in the province after the War; let us hope that Britain will not be too behindhand in responding to the need for technical experts in China. One worker here comes, indeed, from East Malling, Dr. Chang Wen-Tsai. In the Forestry Department, there is little available knowledge about tung oil trees, for example, not possessed by Dr. Li Ying-Chen. Lastly, in agronomy, Dr. Yang Yin-Kuei is working on colchicine polyploidy, and trying to get the farmers to plant maize

* See NATURE, September 25, p. 343.

as an emergency crop, if the rice fails in July, so that they may have it in September.

In medicine and dentistry, Chengtu is as important as it is in agriculture. The medical school of the Huahsi University hospital under Dr. Leslie Kilborn was famous throughout China long before the War, and though it has lost in access to new equipment since, it has gained by the influx of personnel from the evacuated medical schools. Thus in the Department of Pathology there is the eminent Dr. Hou Bao-Chang of Chilu, now interested mainly in medical geography, and ably assisted by Dr. Chiang Ching-Fen, the daughter of Peter Chiang, the first Chinese to study biochemistry at Cambridge. The difficulties of work in China may be illustrated by the fact that all the records of this group were lost by bombing, started again and lost again by fire; work on leprosy had to be stopped for lack of funds, an experimental monkey colony was started, but had to be abandoned owing to financial straits, and all the time they had to make even their own typewriter ink, which faded on the records, and their own Canada balsam from local resins, which often spoiled the specimens. Perseverance is an inadequate word unless we add some adjective such as heroic.

So also in the Physiology and Pharmacology Departments; Dr. Feng Ta-Rjan of Huahsi investigates Chinese drugs such as the anti-dysmenorrhea *tang-kuei* and the uterine stimulant *i-mu-tsao*, while Dr. Chu Rjen-Bao, an incomer from Nanking (and former collaborator of Dr. A. S. Parkes), works on the sex hormones in relation to the pituitary and spermatogenesis. The Dental College, under Dr. Lindsay and Dr. Agnew, was always pre-eminent throughout China, and with such colleagues as the odontal morphologist Dr. Chou Shao-Wo, bears the greatest part of producing first-class modern Chinese dentists. This work is so necessary for the people of China that it ought to be expanded enormously, and deserves the fullest official financial support.

The Huahsi Medical School is not, however, the only one in Chengtu. There is also the Chungyang Medical School, belonging to the National Central University at Sandy Hook, already described in the third of this series of articles. Here also the standard is very high, particularly in the Departments of Physiology (under Dr. Tsai Chiao, now absent in the United States on a lecture tour), Biochemistry (under Dr. Cheng Li-Bin) and Anatomy (under Dr. Pan Ming-Tse). In Dr. Tsai's absence, Dr. Hsu Feng-Yen (a former collaborator of Prof. Lovatt Evans) presides over no fewer than fifteen research workers, including an able young woman from Amoy, Miss Chu Chiung-Yuing, who is studying acetylcholine physiology. Other work concerns a non-histamine smooth-muscle stimulant found in blood, the intestino-intestinal reflex, the anti-hæmolytic action of cholesterol, and a little-understood local disease known as Chiating paralysis and believed to be due to barium poisoning following the use of insufficiently purified salt. Dr. Hsu and Dr. Cheng pointed out to the visitor with justifiable pride perfusion pumps and kymographs all made in the workshops of the medical school itself. As for the Anatomical Department, Dr. Pan and his colleagues pursue a rather original line of study, namely, the physical anthropology of the soft parts, on which Dr. Pan has himself published many papers. Dr. Pan thus combines the interests of his master, the late Sir G. Elliot Smith.

In this connexion, it should be noted that social anthropology is also not lacking at Chengtu. The distinguished anthropologist Dr. Li An-Che (a pupil of Prof. Sapir) heads the Huahsi Institute of Sino-Tibetan anthropology, which deserves much more support than it has so far, in war-time, been able to receive. Mrs. Li An-Che (Yu Sse-Yü), sister of Yu Dao-Chuan, the Tibetan scholar now in England, also works in the field and speaks Tibetan.

Coming now to Chiating, the biological laboratories of Wuhan University are housed, not in the city, but some distance outside it; they include an old stone thick-walled watch-tower which makes an excellent laboratory. It was Dr. T'ang Pei-Sung (now of Kunming) who deserves a great deal of credit for building up biology at Wuhan. To-day Dr. Gao Shang-Yin, who was trained at Yale, with his collaborators, have there the only laboratory in Free China devoted to non-medical bacteriology; while below the ingenious Dr. Shih Shen-Han teaches plant physiology and pathology, and in the watch-tower above Ling Chun-Yo devises new electrodes for blood *p*H and investigates the permeability of erythrocytes. The watch-tower contains one of the few Warburg manometer sets in China. With its lovely view over the river, the watch-tower symbolically reminds one of John Donne's

"But up into the watch-tower get . . ."

though the moral is very different. A pool in the river below the laboratories is no ordinary river pool, for there each year a population of freshwater medusæ develops (2,000 miles from the sea). This medusa has been named *Craspedacusta kiatingi* by Dr. Gao and Kung Li-Hua, who have also made studies of its physiology. The whole group of biological departments is headed by Dr. Chang Ting, a botanist of considerable seniority.

Not far from the city is to be found, on a high eminence beneath a tall pagoda, the National Forest Products Research Station. Under the energetic direction of Dr. T'ang Yao, who until the War was in close contact with forestry in most other countries, this is an active centre. While the United States, for example, has only about a thousand species of forest-trees, China has two thousand; in each case about 10 per cent are really valuable. The Station possesses a fine collection of timber specimens from all over the world as well as China, and an admirable reprint and microfilm collection.

Proceeding down the Yangtze, our next biological port of call would be Tongchi University at Appletree Rapids. Here the biological departments are also extremely good. In physiology there is Dr. H. Stübel, who has worked in China for more than twenty years, and with Dr. Liang Tze-Yen was responsible for some historical work on the fine structure of muscle fibres. In botany there is Dr. Wu Yin-Chan, and in zoology Dr. Tung Ti-Chao, who is undoubtedly the most active experimental embryologist in China to-day. He collaborates with his wife, Dr. Yeh Yu-Fung, and they contrive to produce really excellent work in cramped and very uncomfortable surroundings. This has been done, not only by improvising at all stages, but also because Dr. Tung (a pupil of Prof. A. M. Dalcq at Brussels) chose an important problem which could be worked on with the minimum use of stains, wax, microtomes, etc. This problem is that of the determination of ciliary polarity in the embryo, which the Tungs link up with the determination of antero-posterior polarity as a whole in the inducing tissue. They have made a great step forward by demonstrating that the

inductor for ciliary polarity is a diffusing chemical substance, and they have already established some of its properties; it differs from all previously known inductors in being stable to 50° but not to 100° C. It will diffuse into and out of agar. The fact that such a 'field' property as direction of beat can be determined by a diffusible chemical substance throws light on regional differentiation in general, and agrees with the latest views of such an authority as Dr. Holtfreter at the other side of the world. The British Scientific Mission has been honoured to communicate the memoirs of the Tungs to Western scientific journals for publication.

Little has so far been said in this article about the social sciences, but some distance from Appletree Rapids are a number of spacious manor-houses in the hills in which the Historical and Sociological Institutes of Academia Sinica are established. Headed by two famous scholars, Dr. Fu Se-Nien and Dr. Tao Meng-Ho respectively, they have a staff of some seventy scholars all told, thus constituting the largest institutes of the Academy. They guard indeed many precious treasures, such as some of the world-renowned Anyang oracle-bones, bamboo tablets on which the classics were written, and much of the Imperial Archives. There is even a section on physical anthropology, under Dr. Wu Ting-Lang (a former pupil of Karl Pearson and Elliot Smith), engaged in measuring the skulls excavated in association with the oracle-bones. Space is lacking to describe the concentrated atmosphere of learning which prevails in these Institutes, but those who are interested in the history of science, for example, find much willing and kindly help there. Lastly must be mentioned the existence of the National Archæological Museum in this neighbourhood, directed by Dr. Li Chi, and the Institute for the Study of the History of Chinese Architecture, directed by Dr. Liang Se-Cheng (son of the famous scholar, well known in England, Liang Chi-Chao). The section on linguistics in the Historical Institute (Dr. Li Fang-Kuei) is also interesting, with its great collections of gramophone records of dialects of all provinces of China, and song and speech of many peoples.

It will thus be seen that western Szechuan is extremely rich in matters of biological and sociological interest, even in these difficult times.

It is hoped to describe, in a later article in this series, the scientific situation in the north-west.

HISTORICAL DEVELOPMENT OF MICROBIOLOGICAL METHODS IN VITAMIN RESEARCH

By Dr. MARY SANDFORD

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THE subject of microbiological nutrition, in its qualitative and quantitative aspects alike, is ever gaining increased prominence. Whereas, until some ten years ago the whole abstruse subject served merely as a minor source of contention among bacteriologists, it has now risen to an eminence sufficient to command the attention of research and other workers in several diverse fields of thought. Thus it would seem not inappropriate to outline the historical events through which these changes have been wrought.

The earliest conceptions of the nutritional fundamentals for bacteria arose as a result of the efforts of bacteriologists to cultivate organisms in chemically defined media. Until this was accomplished the study of the biochemical nature of bacteria, and particularly of diffusible substances elaborated during their metabolism, was very seriously hindered owing to the extremely complex and largely unknown constituents present in the medium. In the case of certain organisms, the provision of recognized substances (whether of organic or inorganic nature) furnishing building and energy materials, sufficed for growth; in the case of other organisms, especially pathogenic species, cultivation was singularly unsuccessful unless small addenda of natural products were also provided. Thus there originated the belief that the addenda supplied "accessory growth factors" or "bacterial vitamins", which, it was shown, were active at extremely high dilutions and were destroyed by unfavourable conditions of heat, oxidation, etc., in the manner of the animal vitamins.

The existence of the animal vitamins was not postulated definitely before the end of the nineteenth century, although empirical methods of vitamin therapy had been known from much earlier periods. Not until about 1920, however, were vitamins isolated in pure form, their constitution determined and their synthesis accomplished. During the next phase of vitamin research the studies of pioneers like von Bunge, Lunin, Eijkman, Hopkins, Funk and others led to considerable advances, use being made exclusively of higher animals in which distinctive deficiency diseases were usually recognizable. During this same period other investigators concerned themselves with the problem of the existence and nature of "accessory growth factors" functioning in the nutrition of bacteria and yeasts. The third phase of vitamin research was initiated by a change in ideas tantamount to a revolution. It became recognized that substances hitherto found essential for the growth of lower organisms are at the same time no less important in the metabolism of higher animals. Furthermore, considerable emphasis was placed on microbiological studies owing to the great advantages to be gained.

The fusion of the two methods of approach to the study of vitamins had a very pronounced stimulatory effect on work concerning the B complex. It is notable that at least nine B vitamins are capable of detection by microbiological means. It is a reasonable surmise that if chemists had turned their attention to yeasts and bacteria instead of confining it to higher organisms, they would have had the means at their disposal to isolate all the members of the B complex in a much shorter time than was actually required[1]. Nevertheless, even though the course of vitamin research was such as to lack emphasis on microbiological nutrition, microbes have played a leading part in the isolation of six out of nine B vitamins (pantothenic acid, nicotinic acid, biotin, inositol, *p*-aminobenzoic acid and folic acid).

The history of microbial growth factors may be said to have originated in 1860–70 in the controversy between Pasteur, Liebig and Berzelius concerning the possibility of cultivating yeast in chemically defined media. It was noted that growth did not ensue from small inocula[2]. No advance was made, however, until 1901, when Wildiers, working in Ide's laboratory at Louvain, found that large seedings of yeast into certain media were able to proliferate, whereas small ones failed to do so[3]. Wildiers believed the ability

to grow to be governed by the presence of water-soluble nutrient material in the large inocula. This material he called 'bios'. It is interesting that this word was coined ten years before Funk introduced 'vitamines'.

Wildiers' claims occasioned much sterile controversy during the subsequent twenty years, the existence of complex nutritional needs being absolutely denied by many workers[4]. The situation was clarified by Copping's decision in 1929 that the 'bios' requirement was governed by the type of yeast and by the composition of the medium[5]. Meanwhile Eastcott, working in Lash Miller's laboratory, accomplished a chemical fractionation of bios and isolated i-inositol, which was not otherwise known to be involved in nutrition[6].

Although in 1912 Funk had conjectured a relationship between the then undifferentiated vitamin B and alcoholic fermentation in yeasts, it was not until 1919 that it was suggested that vitamin B might be tested for by measuring yeast growth[7]. However, preliminary work showed that the stimulating substances could be distinguished from vitamin B_1, and the investigation which might have led to the early differentiation of the bios factors was not pursued. Similarly, other assay procedures became abortive when it was ascertained that thiamine was not responsible for the effect[8,9,10,11]; but the work was nevertheless valuable in that it developed the technique of microbiological assays.

Further advances were made possible after 1926 when crystalline vitamin B_1 was isolated from rice-bran[12], thus permitting the investigation of the effect of thiamine alone on yeast growth. Williams and Roehm in 1930[13] stated clearly that Wildiers' bios is a complex mixture of which thiamine is a single component, active in the presence of the other factors. The differences in nutrient requirements of various yeast strains were also recognized, some strains showing no stimulation by any substance readily adsorbed on fullers' earth or precipitated by phosphotungstic acid; such yeasts then cannot be stimulated by vitamin B_1.

Thus in 1930 there was forged the first link connecting the yeast vitamins or bios with the animal vitamins. Since that time many other links have been made. Pantothenic acid was discovered and isolated by its stimulation of yeasts. It was found to be identical with the chick antidermatitis factor[14,15], a factor previously differentiated from riboflavin[16] and from nicotinic acid[17,18]. Pantothenic acid was also found to be identical with a liver factor, isolated by Evans, Happold and Handley, comprising an essential nutrient for certain strains of *C. diphtheriæ gravis*[19], and with a liver filtrate factor required by rats[20,21,22]. It is now recognized as a universal cell constituent, probably common to the metabolic mechanisms of all animals.

Within the years 1939–41 three more connexions were made. Pure pyridoxin, first differentiated clearly as a rat growth-factor B_6 by György[23], was found to stimulate yeasts and therefore constituted a contributing factor to bios[24,25]. Still a further bios factor was concentrated and isolated by Kögl in Utrecht in 1935[26]. This was correlated with the animal vitamins five years later when it was shown to function as vitamin H, the vitamin protecting animals against the specific toxicity due to egg white[27,28]. Yet another link with the animal vitamins was provided when Woolley showed that inositol, known to function in bios, was required as a vitamin by at least one animal, the white mouse. It is remarkable that inositol, unlike most other vitamins, has been known chemically for decades and has only recently been acclaimed as a vitamin[29]. Such was the information which lay hidden in the problem of the nature of bios. Thus yeasts alone might have provided the means of differentiating thiamine, pyridoxin, pantothenic acid, inositol and biotin.

As great a wealth of information was, however, available from studies of other micro-organisms, including fungi and particularly bacteria. The former have not been investigated so thoroughly, but mention may be made of the early and stimulating discovery that vitamin B_1 was essential for the fungus *Phycomyces blakesleanus*[30]. This was the earliest instance of an animal vitamin being indispensable for the growth of a micro-organism, and attempts were soon made to apply the growth-response to measurements of the B_1 content of various products[31].

The volume of work carried out on the vitamin requirements of bacteria, in distinction from other groups of micro-organisms, has been enormous. The conception of essential vitamin-like factors can be traced back between twenty and thirty years. There are many instances in the literature of the need for accessory factors being noted, but little work was performed on the concentration of such factors until about 1935 and onwards. Thus the 'sporogenes vitamin' was first detected by Knight and Fildes[32] and at about the same time a full investigation of the nutritional needs of *Staphylococcus aureus* was made independently by Hughes and Knight[33,34]; in aerobic growth this organism is satisfied with nicotinic acid and vitamin B_1. The biological importance of nicotinic acid had already been shown by Warburg and Christian[35] and Euler, Albers and Schlenk[36], who demonstrated that nicotinamide was a part of the hydrogen-transporting co-enzymes. Later, Lwoff and Lwoff[37] discovered that the Warburg co-enzymes or cozymase functioned as the V factor for *H. parainfluenzæ*. At the same time as Knight was isolating the Staphylococcal factors, J. H. Mueller was concentrating factors essential for the growth of the diphtheria bacillus[38].

Following the recognition of nicotinic acid as a physiologically active substance, animal nutritionists were inspired to test this substance for vitamin activity in higher animals. Nicotinic acid and amide were found potent in curing black tongue in dogs, and nicotinic amide was also isolated from a highly active liver concentrate[39]. Other investigators reported the first successful treatment of human pellagra with nicotinamide[17]. Nicotinic acid, amide and co-enzymes I and II were afterwards found active for organisms of the dysentery group[40], lactic acid organisms[41] and *Proteus vulgaris*[42], and assay procedures based on this activity were proposed.

The components of the bios system were soon recognized to be active not only for higher animals and yeasts but also for bacteria (with the exception of inositol). Thus pantothenic acid was discovered to be required for *C. diphtheriæ gravis*, lactic acid bacteria, *Proteus morganii* and hæmolytic streptococci, and in most cases assay procedures have been proposed[43,44,45,46,47,48].

Vitamin B_6 has been found necessary for *Streptobacterium plantarum* and its use for quantitative purposes suggested[49].

Biotin has already been shown to display widespread biological activity. Besides its well-known

functions as vitamin H and in bios, it is contained in the respiratory co-enzyme required by the nitrogen-fixing symbiotic bacteria inhabiting the root nodules of leguminous plants. Biotin is required by the organism *Cl. butylicum* and is known to stimulate members of the acidophilus group of bacteria.

A vitamin not previously mentioned is riboflavin. This is not a member of the bios complex, but is necessary for many higher animals and for certain bacteria. It was isolated from yeast in the form of the 'yellow enzyme' by Warburg and Christian[50]. Riboflavin is well known in the microbiological field for its growth-promotion of *Lactobacillus casei* and related organisms[51,52], this being the basis for many modified assay procedures.

Recently, another compound has been added to the list of the water-soluble B vitamins. This is *p*-amino-benzoic acid. The recognition of the growth-stimulating action of the acid is closely bound up with the theory propounded by Fildes to explain the action of chemotherapeutic agents in preventing the metabolism of pathogenic organisms. Fildes postulated that the chemotherapeutic agent threw out of gear certain enzyme systems in the parasite and that this was accomplished by virtue of the great chemical and structural similarity between the therapeutic agent and one of the co-enzymes[53]. On the basis of this hypothesis it was to be assumed that there existed in animal tissues a substance closely related to sulphanilamide, the function of which was essential to cell metabolism and which, if not capable of being synthesized by the organism itself, would be thereby classified as a vitamin. In 1940 an antagonistic action of *p*-amino-benzoic acid against sulphanilamide was noted *in vitro*[54]. Then it was found that yeast extracts would inhibit sulphanilamide activity and the suggestion was made that this was due to *p*-amino-benzoic acid in the yeast[55]. Furthermore, an *in vivo* inhibition in mice was also observed[56]. The isolation of *p*-amino-benzoic acid from yeast was soon reported[57]. The expected link with animal nutrition was forthcoming the following year when *p*-amino-benzoic acid was shown to be a chromotrichia factor for the rat and a growth-promoting factor for the chick[58]. In general the evidence so far available indicates that *p*-amino-benzoic acid is widely distributed throughout the vegetable and animal kingdoms.

Thus, it is at once apparent that no real distinction exists between the 'animal vitamins' of the B complex and bacterial growth-factors. In not a single instance has a vitamin been shown to have an action for higher animals exclusively, while the great majority, if not all, of the microbiological growth-factors are either essential in the diet of the higher animals or have been shown to be synthesized by the latter.

It is certain that the roll of known vitamins is still incomplete. When, therefore, the task of identification has been terminated, and when rapid and accurate methods of determining each member have been established, it would appear that conditions will then be most favourable for investigating the precise function of the B vitamins. It is not unreasonable to suppose that a thorough comprehension of vitamin function will constitute an advance of immeasurable value in the control of metabolic processes—normal or abnormal—in man and animals.

[1] Williams, R. J., *Science*, **93**, 412 (1941).
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OBITUARIES

Prof. Susan Stebbing

DR. L. SUSAN STEBBING, since 1933 professor of philosophy in the University of London (Bedford College), died on September 11 at the age of fifty-seven at Tintagel in Cornwall. Educated at Girton College, Cambridge, she read for both parts of the Historical Tripos and for Part I of the Moral Sciences Tripos. In 1912 she graduated M.A. in philosophy, with mark of distinction, at London. After acting as director of moral science studies at Girton and Newnham, Dr. Stebbing was appointed successively lecturer, reader and professor in philosophy in the University of London.

It was unquestionably to the work of contemporary philosophers at Cambridge that the very marked bent of Prof. Stebbing's philosophical interests and orientation are to be traced. Accepting in the main the 'charter' of the scope and method for all future philosophy set out by Bertrand Russell in his Lowell Lectures, she adopted his recommendation of a piecemeal and co-operative treatment of problems by an 'analytical' method, though in the actual pursuit of this aim and in determining what this analytical method should be, she was less influenced by Russell. Here, as she herself declared, her indebtedness to Prof. G. E. Moore was the profoundest and most continuous through her life, though she also often expressed how much she owed to such other Cambridge philosophers as A. N. Whitehead, C. D. Broad, W. E. Johnson and L. Wittgenstein. Her energies were for the greater part afterwards devoted to the three fields of mathematical logic, the methodology and philosophy of the sciences, and the analysis of problems concerning perceptual knowledge of the external world.

A close and prolonged study of Russell and Whitehead's "Principia Mathematica" and of the works of most other formal logicians present and past eventually entitled her to the rank of an authority in that science. How clear and sure was her grasp of its detail is evident from the article "Logistic" contributed to the "Encyclopædia Britannica" (14th edit.) and in her "Modern Introduction to Logic" (1931)—now in its third edition—in which she skilfully combined the essentials of the newer with those of the traditional logic, and corrected and modernized the theory of scientific method inherited from Mill.

It is in this field that her best work is found, though to readers of NATURE Prof. Stebbing is probably better known as the author of "Philosophy and the Physicists" (1937), where, with much caustic comment, she rigorously examined the attempts of Sir James Jeans and Sir Arthur Eddington to elucidate the philosophical implications of recent developments in mathematical physics. Jeans's argument for the existence of a Great Architect whose activity is that of a pure mathematician and whose thoughts constitute the universe, she rejected as metaphysical extravagance. She complained that these writers, instead of enlightening the common reader, confuse him by approaching their task through "an emotional fog" and by excessive use of personification and metaphor. In the interpretation Eddington placed on his assertion that "the aim of science is to construct a world that shall be symbolic of the world of common experience", she protested at his restricting physical knowledge to the ascertainment of 'pointer-readings' and their connexions, and to his affirming an unknown background correlated with them, the existence of which, she maintained, on his own premises, he ought never to know or even suspect. She likewise objected to his regarding the laws of conservation, gravitation and Maxwell's equations as truisms and not 'controlling laws'; to his assertion that the familiar objects of perception are mere products of "mind-spinning"; to the blurred and indefinite reference in his use of such phrases as "the familiar world", "the external world", "the physical world", "the scientific world", "Nature", "the spiritual world", etc., and the failure to show how one was conceived to be related to another. She condemned, too, Eddington's frequent and large use of the metaphor of 'building' and constructing, and complained that he "nowhere expounded his philosophical ideas in non-popular language", though the communication of exact thought is impossible in inexact language.

Despite the asperity of her stricture, Prof. Stebbing's thinking throughout her writing and teaching generally was strenuous and clear-headed. She spared not herself and strove for consistency, and her judgment, if not highly original, was certainly highly independent. Her students, with whom she was very popular, and her colleagues will deeply deplore their loss.

S. V. KEELING.

Sir Francis Fremantle, O.B.E., M.P.

BY the death on August 26 of Sir Francis Fremantle, Great Britain loses the services of a man who devoted the greater part of his life to the promotion of the national health. He was born in 1872, a great-great-grandson of one of Nelson's captains, and fourth son of the Hon. William Fremantle, Dean of Ripon. He chose medicine for his future profession while still a King's Scholar at Eton.

After taking honours in physiology at Oxford, Fremantle did the usual clinical appointments at Guy's, and was one of the very few men to hold both the D.M. and M.Ch. degrees, later also becoming a fellow of both of the Royal Colleges. He served as a civil surgeon in the South African War, and in 1902 acted as assistant secretary to the War Office Commission for the Reorganisation of the Army Medical Service. He then spent several years preparing for the career he had mapped out for himself already in his Balliol days—that of a medical member of Parliament. With this object in view he took the appointment of medical officer of health for Hertfordshire in 1902. He obtained leave of absence to act as plague medical officer in the Punjab in 1903 and special correspondent of the *Lancet* in the Russo-Japanese War in 1904, and to tour the Empire in 1911. He described his varied experiences in "A Doctor in Khaki" (1901) and "Health and Empire" (1911). He served in Gallipoli, Egypt and Mesopotamia in the War of 1914–18 as D.A.D.M.S.

From 1919 until his death Fremantle was Conservative M.P. for St. Albans. He soon became recognized as the leading spokesman of the medical profession in the House of Commons, and was accepted as an authority in all matters relating to the public health. From 1923 he was chairman of the all-parties Parliamentary Medical Committee. He was a member of the Industrial Health Research Board, the Departmental Commission on the Midwives Act, the Central

Housing Advisory Committee of the Ministry of Health and the Inter-Departmental Committee on Nursing.

Fremantle always tried to put before the House of Commons the strictly medical and scientific aspects of the subject under discussion. He was most conscientious, and was very regular in his attendance. Though not brilliant, he was extremely painstaking, and his opinions always received the attention they deserved. During the recent debate on the decline of the population he spoke with great earnestness on the causes and probable effects of the declining birth-rate on the future of the nation. His books brought his views on health problems before a wider public. In addition to those already mentioned, they included works on "The Housing of the Nation", in which he pointed out the shortcomings of housing as they appeared to a medical officer of health in 1927, and on "The Health of the Nation" (1928).

Fremantle was much liked by members of all parties in the House and was equally popular with all classes in his constituency, where he was D.L. and J.P. He lived at Bedwell Park, near Hatfield, and was knighted in 1932. He married Dorothy, daughter of the late Mr. H. J. Chinnery, of Bicester, in 1905 and had one son, Lieut.-Colonel David Fremantle.

ARTHUR HURST.

Prof. T. J. Jehu

PROF. THOMAS JOHN JEHU, who was born at Llanfair-Caireinion, Montgomeryshire, in 1871 and who died at Edinburgh on July 18, will be long remembered for the striking and comprehensive series of investigations he planned and carried out, in conjunction with other members of the staff of the Geological Department of the University of Edinburgh, on the metamorphic and igneous rocks of the Highland Border Series at Aberfoyle and on the Archæan complexes of the Outer Hebrides. His active life falls into three periods: (1) the period of preparation and of post-graduate research; (2) the period of his tenure of the lectureship in geology at St. Andrews; and (3) the period—from 1914 onwards—during which he occupied the regius chair of geology and mineralogy at Edinburgh.

Jehu received his early education at Oswestry High School and thereafter matriculated at the University of Edinburgh, passing through the Faculties of Medicine and Science and graduating M.B., C.M. in 1893 and B.Sc. in 1894. He was early attracted to the study of natural history and, under the inspiring guidance of Prof. James Geikie, laid the foundations of a life-long interest in geological research. He continued his studies at Cambridge, where he had a distinguished career, gaining a first class in both parts of the Natural Sciences Tripos in 1897, and a second class in the Moral Sciences Tripos in 1898, besides winning the Newcombe Prize in Natural Science at St. John's College (1898). During the tenure of a Heriot Fellowship at Edinburgh he completed a valuable bathymetrical and geological study of the lakes and rock-basins of Snowdonia and eastern Carnarvonshire, published in 1902. In 1900 he was elected to the fellowship of the Geological Society of London and in 1902 received the degree of M.D. from the University of Edinburgh.

In 1903 Jehu was appointed to the lectureship in geology at St. Andrews, where the organization of this newly established department and his lecturing and tutorial duties both at St. Andrews and at Dundee demanded most of his energy and time. He found opportunity, however, to prepare and publish two important papers dealing with the glacial deposits of northern Pembrokeshire (1904) and of western Carnarvonshire (1909), in which he discussed in detail the succession of events in the glacial history of these areas and emphasized the evidence provided by the deposits for an extension of the Irish Sea ice. In 1906 he was appointed a member of the Royal Commission on Coast Erosion and took a prominent share in drafting the reports and findings of the Commission issued between 1907 and 1911.

In 1914 Jehu succeeded his old teacher James Geikie as regius professor at Edinburgh, a position which he held until his retirement, on account of increasing ill-health, in June last. To this period belong the outstanding series of contributions to Scottish geology referred to at the beginning of this notice. Following on his discovery of fossils of Cambro-Ordovician age in the Highland Border rocks of the Aberfoyle district, first announced in NATURE of June 6, 1912, he undertook, in conjunction with Dr. R. Campbell, a detailed investigation into the geological succession and structure of this complicated region, the results of which appeared in 1917. This was followed in 1922 by his paper on the Archæan and Torridonian Formations and Later Igneous Rocks of Iona, and in later years by the extended series of researches which he carried out in collaboration with Dr. R. M. Craig on the geology of the Outer Hebrides. The "Geology of the Barra Islands" was the first of this series, appearing in 1923, and was followed by "South Uist and Eriskay" in 1925, "North Uist and Benbecula" in 1926, "South Harris" in 1927, and "North Harris and Lewis" in 1934. This sequence of papers, in which the old gneisses, the later intrusive rocks and the glacial phenomena of the long chain of islands forming the Outer Hebrides were first described in detail, represents a striking contribution to Scottish geology, and its importance was recognized by the award to the authors by the Royal Society of Edinburgh of the Neill Medal and Prize for the period 1925–27. Among the outstanding results of this extended research was the mapping in detail of a belt of highly crushed and mylonitized rock ('flinty crush') along the whole eastern boundary of the islands from Barra to Lewis, a feature which Dr. J. W. Dougal had already noted in 1911.

Jehu's tenure of the Edinburgh chair was also notable for the transference of the Geological Department from restricted and unsuitable premises in the Old College, first to temporary accommodation on the outskirts of the city in 1923, and then in 1931 to the specially designed and well-equipped Grant Institute of Geology.

Most of Prof. Jehu's research work appeared as papers in the *Transactions of the Royal Society of Edinburgh*, but he also contributed to other scientific publications such as the *Geological Magazine*, the *Scottish Geographical Magazine*, the *Transactions of the Antiquarian Society of Scotland*, etc. Before illness laid him aside, he took a prominent part in the various academic and scientific activities of Edinburgh; he represented the University, for example, on a number of public bodies, served as vice-president of the Royal Society of Edinburgh from 1929 until 1932, and was president of the Edinburgh Geological Society during 1917–18.

M. MACGREGOR.

Mr. F. F. Renwick

I JUST missed Renwick at the City of London School. He entered at about the same time as I left and had thus the good fortune to come into contact with Owen Glynne Jones, whose chemical knowledge must have proved a valuable stimulus to Renwick's interest in chemistry. After leaving, he went to the Science Section of the City and Guilds Institute at South Kensington, where he had the privilege of being under Armstrong. He was also in close contact there with Pope, with whom he remained friends for the rest of his life, and he became well acquainted with Philip, an acquaintanceship which helped to further his social development.

Renwick joined the staff of Ilford, Ltd., in 1898, but I had no contact with him until 1910, when I also joined the firm. I remember well those early days when three chemists were for some years the whole of the scientific staff of Ilford, Ltd., those three chemists being Renwick, Store, and myself. I also remember the interminable discussions, not on chemical matters but on politics and above all on religion. One of us was a broad-minded Church of England man, the second a broad-minded Unitarian and the third an Agnostic. Never did those three agree and never did they come to any conclusion, each termination of the argument leaving each of the men with his own point of view intact.

The work in those days consisted of emulsion experiments and constant work on Ilford "pinpoints". This necessitated the use of a high-powered microscope and an everlasting endeavour to recognize the minute particles, chiefly in the gelatine, which were the cause of the particular trouble under review. It was not long, however, before this work gave way to problems which were more intricate and harder of solution. Such problems included the behaviour of translution densities when in optical contact with one another, and I recall the months of argument which went on before the final paper on luminosity by Renwick, Store and Channon was published by the Royal Society.

Renwick's scientific work dealt with at least three recurrent themes. The first of these, photographic sensitometry and tone reproduction, with its fundamental problem of the significance and the measurement of photographic densities, developed stage by stage throughout his working life. Arising from that work he made, with W. B. Ferguson and D. E. Benson, the "F.R.B. Densitometer" which was to serve for many years as a standard. Armed with this instrument, he turned his attention to the broader question of photographic tone reproduction. This led him to consider the desirable sensitometric properties of photographic papers. Secondly, he made contributions to the theory of the photographic latent image. In 1920 he advanced the view that the action of light is to coagulate particles of silver present in the sensitive grains of an emulsion, so as to form a centre large enough to act as a nucleus for development. His third quest was for a photographic material, incorporating fluorescent substances, which would have a greatly enhanced sensitivity to X-rays. Using complexes of lead sulphate and barium sulphate, very efficient and relatively cheap X-ray intensifying media were produced under the names "Kryptoscreen" paper and "Brytex" intensifying leaves.

In 1922 Renwick left for the United States to take charge of the Dupont Film Factory and remained there until 1925, when he came back to England because he felt that the education of his children should take place in their own country. When he returned to Ilford, Ltd., he came as a director.

I have vivid memories of long walks prior to his stay in America. After his return he was too busy to indulge in much walking; had he been able to continue I think his health would have been the better for the exercise.

Naturally, as Renwick's responsibilities increased and the Royal Photographic Society took up more and more of his spare time, not to mention the demands of his growing family, we saw less of one another on the social side. In the latter (war) years of his life he also shouldered the added responsibilities of A.R.P. duties.

Those of us who knew him well feel that we have lost a master of photographic science who can ill be spared from the excellent work he was doing, and know that we shall not be likely to see his equal again.

O. BLOCH.

Mr. R. Borlase Matthews

WITH regret we have to record the passing under tragic circumstances of another pioneer in electrical engineering. Following a bathing accident in which his eighteen-year-old son David was drowned, Mr. Richard Borlase Matthews, who had gone to the boy's rescue, died on August 20 from the effects of shock and exhaustion.

Born in 1876, Mr. Matthews was educated at the Grammar School and Technical College, Swansea, at the Royal School of Mines, and at the Royal College of Science and Central Technical College, London. After serving his apprenticeship with the Milbrook Iron and Steel Company, Swansea, he became assistant engineer with Robert Blackwell and Co., afterwards going to the United States, where he joined the National Electric Co. at Milwaukee, then the General Electric Co. at Schenectady and later the Edison Electric Light and Power Company at Amsterdam. Returning to England, he practised as a consulting engineer in 1906, and specialized in high-voltage electric transmission, the design of power stations, and the applications of electricity to heating and domestic purposes. In 1908 he took up aeronautical work and during the War of 1914–18 he was in the Applied Design (Liaison) Department of the Air Ministry. Afterwards, on his 600-acre all-electric farm at Great Felcourt, East Grinstead, Sussex, he carried out extensive experiments on the application of electricity to agriculture, and published a number of papers on the subject. In collaboration with Dr. Ekstrom, Mr. Matthews initiated a scheme for electricity supply in the areas now served by the Mid-Lincolnshire Electric Supply Co. and in 1930 he was appointed a director of the Company.

Mr. Matthews was a Whitworth exhibitioner, a member of the Institution of Electrical Engineers and an associate member of the Institution of Civil Engineers, as well as a fellow of the Royal Aeronautical Society.

WE regret to announce the following deaths:

Dr. G. E. Pilgrim, F.R.S., formerly superintendent of the Geological Survey of India, on September 15.

Dr. F. J. W. Whipple, formerly superintendent of the Kew Observatory, on September 25, aged sixty-seven.

NEWS and VIEWS

Scientific Director of the Zoological Society of London: Prof. Edward Hindle, F.R.S.

THE appointment of Prof. Edward Hindle, regius professor of zoology in the University of Glasgow, to the post of scientific director of the Zoological Society of London, is in implementation of the policy, decided on more than a year ago, to replace the paid secretary of the Society by an honorary secretary in accordance with the practice of most learned societies. It was then foreseen that it would also be necessary to have another officer who would carry out much of the work performed by the former paid secretary. Dr. Hindle, as the first occupant of the new post now created, will therefore be mainly concerned in organizing all the more scientific branches of the Society's work, such as the scientific meetings, the publications and the library, as well as the prosectorium; he will also deal with scientific problems concerning the collections of animals at Regent's Park and Whipsnade.

Prof. Hindle, in addition to having a wide knowledge of zoology, has travelled much and has visited most of the Zoological Gardens of the world. Since he went to Glasgow in 1935, he has taken a keen interest in starting a Zoological Park there, and is president of the Zoological Society of Glasgow, in the foundation of which in 1937 he was concerned. He is also on the council of the Zoological Society of Scotland at Edinburgh, a member of the Scottish Nature Reserves Committee, and chairman since 1935 of the executive committee of the Scottish Marine Biological Association. His many other activities include considerable editorial experience, for he is joint editor of the *Quarterly Journal of Microscopical Science* and of *Parasitology*, and sectional editor of the *Tropical Diseases Bulletin*. His research interests have been mainly in the field of protozoology, particularly infections transmitted by insects. Since 1936 he has been Lieut.-Colonel in command of the University of Glasgow O.T.C., and since the War has been in charge of the recruitment and training of potential officers in the west of Scotland. It is hoped that Prof. Hindle will be able to take up his duties in January.

Industrialization in China

THE broadsheet "Poverty and Progress in China" recently issued by Political and Economic Planning (P E P) (No. 209) gives a concise but useful account of the social and economic situation in China, wartime changes and achievements and comments on post-war industrialization. About three-quarters of China's population, or 360 million people, draw their living from about 250 million acres, or only 11 per cent of the total area of China. While much of the remainder is definitely unfit for cultivation, some part of it could be used for agricultural purposes if irrigation were provided and scientific methods of farming used. By modern standards, Chinese agriculture is heavily under-capitalized and over-manned, the Chinese farmer grossly under-fed and overworked. Excessive rents are also a serious matter, but the poverty of communications is one of the greatest causes and consequences of China's material backwardness. Most of the known mineral resources are as yet unexploited, but raw materials required for the consumer goods industries can be supplied at home and some, such as silk, wool, tobacco, leather, furs and bristles, have long formed staple exports. China became almost self-sufficient in raw cotton by 1929.

With regard to the effects of Japanese occupation, at least five of China's six major industrial regions have fallen under Japanese control, as well as the major ports, much of the road and railway network, important mineral resources and the major cotton- and wool-producing areas. The stout resistance put up in face of the invasion, however, gave the Chinese time to evacuate some of their industrial equipment to the interior, and the Government has directly undertaken industrial projects especially in heavy industry and in electricity. It has also gradually assumed control of the allocation and prices of essential materials and of the distribution of labour, but effective administrative control has been hampered by the shortage of experienced personnel, by the size of the country and the poverty of its communications and by inflation. The Chinese industrial co-operatives have played an important part in absorbing moderately skilled workers and craftsmen whose services could not be speedily utilized by the transferred private or Government industry. In regard to post-war industrialization, the broadsheet considers that industrial co-operation may have a great future in China, but will require greater support in the form of cheap credit. Technical and managerial assistance from abroad as well as machines and equipment will also be essential, but population pressure may remain the crucial problem until adjustment is facilitated by improvements in educational standards and enlightenment about family limitation.

U.S. Department of Agriculture

A SUBSTANTIAL part of Dr. Karl T. Compton's Pilgrim Trust Lecture, "Organization of American Scientists for the War", appeared in NATURE of May 29, p. 601. The Information Service of the U.S. Department of Agriculture has pointed out that some of Dr. Compton's remarks about that Department require modification. The Department's initial work was in the field of scientific research, the introduction of valuable plant species, entomology, botany, chemistry, meteorology, and so on. Its first bureau, the Bureau of Animal Industry, was created by an Act of Congress of May 29, 1884, and still carries out research in animal diseases, breeding, feeding, and management of domestic animals, and related subjects. On March 2, 1887, an Act was passed which authorized the establishment, under the direction of the land-grant colleges, of stations in each State to conduct agricultural experimentation. The Office of Experiment Stations was established in the Department of Agriculture, in 1888, to act as a staff agency to administer Federal grants involved in this and subsequent supplementary legislation, and to co-ordinate researches.

On December 13, 1941, a major re-organization of the Department of Agriculture was announced in connexion with the war effort; this was validated on February 23, 1943. Seven of the old scientific bureaux and agencies, concerned largely with research work, were combined to form the Agricultural Research Administration. Included also were the four large Regional Research Laboratories, authorized in 1938, and established at Peoria, Ill., Albany, Calif., Philadelphia, Pa., and New Orleans, La.; the nine Bankhead-Jones Laboratories for research on special agri-

cultural projects; and the Beltsville (Md.) Research Center. At the same time, some of the Bureaux were renamed as follows: Bureau of Animal Industry, Office of Experiment Stations, Bureau of Entomology and Plant Quarantine, Bureau of Human Nutrition and Home Economics, Bureau of Dairy Industry, Bureau of Plant Industry, Soils, and Agricultural Engineering, and the Bureau of Agricultural and Industrial Chemistry. The work of the Regional Research Laboratories is now closely integrated with the last.

In addition to these agencies in the Agricultural Research Administration, the Department of Agriculture carries on considerable scientific research in the Forest Service and in the Soil Conservation Service. The Forest Service works in twelve forest and range experiment stations, and the Forest Products Laboratory at Madison, Wis.; the Soil Conservation Service investigates soil erosion and water depletion, and develops methods of soil and water conservation in co-operation with State agricultural experiment stations. Finally, the Bureau of Agricultural Economics is the central statistical and economic research agency of the Department, and has done outstanding work in social and economic science. As a result of Presidential Reorganization Plans announced in 1939 and 1940, the Weather Bureau was transferred to the Department of Commerce, the Food and Drug Administration to the Federal Security Agency, the Bureau of Public Roads to the Federal Works Agency, and the Bureau of Biological Survey to the Department of the Interior, where it became part of the Fish and Wildlife Service.

Summer School in X-Ray Crystallography

A SUMMER SCHOOL in X-ray crystallography for scientific workers in industry, which was first suggested at the second conference on X-rays of the Institute of Physics, was held in Cambridge during September 6–18. It was organized by the Board of Extra-Mural Studies of the University in co-operation with the Cavendish Laboratory and the Department of Mineralogy and Petrology. Only about one third of the applicants could be accommodated; the whole course was attended by twenty-two, and, in addition, a small number were present for one week. The main object of the course was to familiarize X-ray workers in industry with the techniques used in solving fundamental problems. Thus they should be better fitted for dealing both with the routine work in industrial organizations and with the special problems that arise from time to time. Accordingly the earlier part of the course was devoted to the study of single-crystal X-ray photographs, and possible and actual practical applications were pointed out. The orientation of diamonds in the making of dies for wire drawing and of artificial sapphires for pivot bearings were two such examples.

The latter part of the course dealt mainly with powders and polycrystalline aggregates, with special reference to metals. The applications of X-ray methods to the study of equilibrium diagrams, of stress and strain, and of preferred orientation in wires and sheets, were described in detail; these were augmented by a lecture by Sir Lawrence Bragg on "The Strength of Metals". The identification of materials by the X-ray Index of Powder Photographs was also dealt with. Nineteen lectures were given altogether, by Drs. N. F. M. Henry, H. Lipson and W. A. Wooster: each lecture was followed by two hours of practical work in which assistance was given by Miss A. M. B. Parker and Dr. D. P. Riley. Since it was not possible for the students actually to use the X-ray apparatus, the practical work was based on photographs or measurements already in existence. Opportunity to see and handle the apparatus was given in special visits to the research laboratories of the Department of Mineralogy and Petrology and the Cavendish Laboratory. The course was noteworthy as an example of fruitful collaboration between industry and a university. At the present time many industrial firms make great use of X-ray diffraction methods, and at the same time, university teachers, in order to train students effectively, need to keep in touch with the practical requirements of industry.

The Cannibal Complex

PROF. J. H. HUTTON'S presidential address to the Folk-lore Society deals with the subject of cannibalism (*Folk-lore*, **54**; 1943). The thesis is upheld that the origins of the practice were many and various, and that several causes were responsible for the growth of the custom among any given people. Among the reasons for the eating of his own kind by man, Prof. Hutton enumerates the following: famine, lack of meat food in the case of folk living largely on such starchy materials as potatoes and manioc, etc., revenge, and magic. In the last case ideas of sacrifice, of obtaining the life essence or qualities of the person eaten, and of getting an extra 'dollop' of soul-stuff by the same means can be traced. One is told that 'long pig' makes good eating, but Prof. Hutton does not include this possible motive. It would appear that no one of these reasons by itself is sufficient to generate the custom—indeed the fact that among some cannibals only criminals are eaten suggests that, on the whole, man does not relish eating man. When, however, several of the above factors operate, for example, when famine has started the practice, then it may develop into a custom as a result of the operation of one or more of the other motives. Such an analysis of a 'savage' practice is very interesting and helps to show the ordinary Englishman how complex are the ideas of modern primitive peoples.

The Cuscatlan Bridge in El Salvador

THIS bridge is the largest in Central America, and has been erected across the Lempa River, to complete another link in the Pan-American Highway (*Earthquake Notes*, **14**, Nos. 3 and 4; June 1943). The main suspension span of 820 ft. is carried by cables of open construction chosen to fit the unusual erection conditions. The bridge is near the base of an extinct volcano, and test borings indicated that the foundations and anchorages would be in volcanic materials consisting of cemented ash and loose boulders or stones. These materials lie in very irregular strata and pockets. Since the bridge may be subjected to earthquake shocks, special care was necessary to support the assumed earthquake forces in the design of the concrete approaches. A study of this feature indicated that multiple-span rigid-frame structures were required. A factor in the design of structures built to resist earthquakes is the natural period of vibration. Resonance must be avoided by making this different from the supposed destructive earthquake frequencies likely to arise in the district. In this case periods of from 0·5 sec. to 1·5 sec. were avoided. The natural periods of the transverse bents of the Lempa River Bridge concrete

approaches is less than 0·5 sec. and that of the longitudinal frames is of the order of 0·25 sec. A factor contributing to the safety of the longitudinal frames against resonance is the varying heights of the columns, each of which has a natural period of its own different from the others. Tunnel anchorages have been used. The principal mass of the bridge is contained in the main-span trusses and the floor, and this mass would produce the greatest transverse earthquake force on the towers at the level of the trusses. The cables have a small mass but transmit heavy loads to the towers. The earthquake forces on the towers from the cables would be small, and the conservative design of the bridge was not affected by the assumed earthquake forces.

Distribution of Typhus

ACCORDING to an editorial in the March issue of the *Boletin de la Oficina Sanitaria Panamericana* the Panamerican Committee on Typhus and other Rickettsial Diseases set up by the eleventh Pan-american Congress held in Rio de Janeiro in September 1942 has come to the following conclusions. With improvement in the methods of investigation the number of cases and the extent of the geographical areas are becoming more apparent. In Chile and more recently in Bolivia and Columbia there have been several epidemics of typhus. Sporadic cases or small epidemics have been repeatedly notified in the Argentine, Brazil, Peru, Ecuador and Venezuela, while in Central America serious outbreaks have been reported in Guatemala as well as cases in El Salvador, Honduras and most of the Caribbean Islands such as Cuba, Puerto Rico and Jamaica. These diseases form one of the major health problems in some parts of Mexico and the United States, and cases have also been seen in Canada. The rickettsiases found in America may be classified into the following four groups: (1) epidemic, classic, European or louse-borne; (2) endemic, murine or flea-borne; (3) Rocky Mountain spotted fever; and (4) *Q* fever or nine mile fever, Japanese river fever or tsutsugamushi apparently not found hitherto on the American continent. The problem is particularly serious at the present time owing to the War, the rapid transportation of large numbers of persons to and from infected zones and the difficulty of enforcing maritime and aerial quarantine.

Earthquakes Registered in Spain

DURING May and June 1943, forty-five earthquakes and earth tremors were registered by the five Wiechert seismographs at the Observatory at Toledo, according to provisional bulletins just received. During May there were sixteen shocks, the strongest recording being on May 25, when an earthquake beginning with an unidentified emergent pulse at 23h. 22m. 23s. attained a maximum amplitude of 480 μ on May 26 at 00h. 09m. 17s. An earthquake with an estimated depth of focus of 230 km. began recording with *iPze* at 17h. 29m. 54s. on May 2. During June there were twenty-nine shocks registered. The greatest registration was on June 13, when an earthquake, beginning with *iPz* at 5h. 24m. 56s., attained a maximum amplitude of 270 μ at 6h. 05m. This shock had a depth of focus of 100 km. The shock of June 20, which was reported as destructive at Adapazar in Turkey, first registered at 15h. 38m. 29s. and attained a maximum amplitude at Toledo of 41 μ at 15h. 51m. (NATURE, July 3, p. 17).

Ciencia

AN editorial note in the first issue for 1942 of *Ciencia: Revista hispano-americano de Ciencias puras y aplicadas* (published in Mexico) expresses the hope that its publication, interrupted for a time, will be regular and punctual in the future. Issues for the first half of 1942 deal with a great variety of subjects, some of cultural interest, others of a practical and technical character, and in addition, it contains short items of scientific importance from a great number of countries. Of special interest is a series of articles (not yet completed) by Prof. B. Cabrera, of the National University of Mexico, entitled "El Atomismo y Su Evolucion", which provide an excellent account of the developments in our knowledge of atomic physics from the days of Democritus and Leucippus up to modern times. Dr. Honorato Castro contributes an article on the determination of the distance between two points on the earth's surface with sufficient accuracy to serve the needs of aviators. A spherical earth is assumed in the first case, and then it is shown how corrections can be applied when an ellipsoidal earth is considered. Biological and medical subjects are prominent, and among the latter may be noticed an important article by Dr. S. Obrador Alcalde, with the title, "Mecanismos Neurales De Los Ritmos Electricos De La Corteza Cerebral". The author, who is connected with the Laboratory of Medical and Biological Research, School of Medicine and Institute of Neuro-Psychiatry, Mexico, deals with investigations. These few references will suffice to show the scope of the journal, and it may also be mentioned that a considerable amount of space is devoted to reviews of scientific works.

Announcements

DR. A. H. ROSENTHAL, well known as a physicist and electronic engineer, has been appointed director of research and development of Scophony Corporation of America. Dr. Rosenthal has been connected with Scophony, Ltd., of London, for several years, and in his present position will head a group of scientific men and engineers engaged in research and development of fundamental inventions, not only in television, but also in the ever-widening field of electronics, including various applications of supersonics.

THE inaugural meeting of the X-Ray Analysis Group of the Institute of Physics will be held, by invitation of the Manchester and District Branch of the Institute, in the Physics Department of the University of Manchester on October 16. Sir Lawrence Bragg will open the meeting with a lecture on "The Physical Optics of X-Ray Analysis", which will be followed by four short papers and an exhibition of X-ray apparatus relating to industrial problems.

THE late Sir Horace Boot, the distinguished engineer, has bequeathed £5,000 to the Institution of Civil Engineers and £1,000 each to the Institutions of Mechanical and Electrical Engineers.

REFERENCE was made in NATURE of September 25 (p. 352) to the new American publication, *Mathematical Tables and Aids to Computation*. We are asked to state that the agent in Great Britain for this periodical is the Scientific Computing Service, Ltd., 23 Bedford Square, London, W.C.1 (subscription £1).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Urinary Elimination Products Following Ingestion of Nicotinamide (F_2 of Najjar and Collaborators)

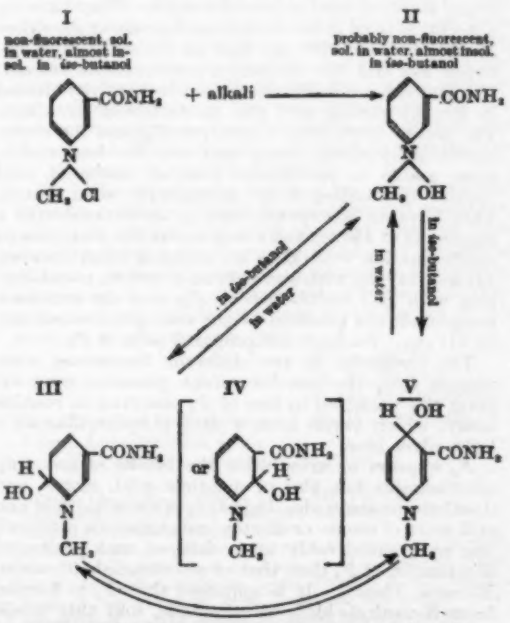
ABOUT three years ago Najjar and collaborators[1] started publishing a series of papers on two pigments eliminated respectively in urine of pellagrins (F_1) and of normal persons (F_2); the F_2 output is increased after the intake of nicotinamide and related compounds. Both pigments could be made visible by the following method. Urine was adsorbed on 'Decalso' (a synthetic zeolite), the adsorbate was eluted with 25 per cent potassium chloride and the neutral potassium chloride eluate was extracted with *iso*-butanol to obtain F_1, while F_2 was extracted after the alkalinization of the potassium chloride eluate. In long-wave ultra-violet light F_1 showed a violet and F_2 a silver-blue fluorescence. Coulson, Ellinger and Platt[2], when examining concentrates of F_2, observed a number of properties of F_2 (absorption spectrum, emission spectrum, behaviour towards hyposulphite, changes of fluorescence with the *p*H and sublimation in high vacuum) which suggested the similarity of F_2 to thiochrome. Recently Najjar, Scott and Holt[3], and Huff and Perlzweig[4], published papers on the probable nature of F_2. The former discussed the similarities and dissimilarities of F_2 to reduction products of N-methyl-nicotinamide prepared according to Karrer *et al.*[5]. The latter showed a number of properties of F_2 which were identical with those of N-methyl-chloro-nicotinamide. These publications prompted us to publish the results of the present state of our investigation.

Large amounts of urine collected after the intake of large doses (200–750 mgm.) of nicotinamide were filtered through 'Decalso' columns; the columns were eluted with potassium chloride, the alkalized potassium chloride eluates extracted with *iso*-butanol, and the dried *iso*-butanol extracts concentrated in the early experiments *in vacuo* at about 60°. Non-fluorescent solids were removed from the concentrates and the extract was taken down to a thick yellow oil which would not crystallize. Fractional sublimation in high vacuum showed the presence of at least five fluorescent constituents all of which were coloured. Filtration of the *iso*-butanol solution of the concentrate through an Al_2O_3 column revealed the presence of at least five fluorescent substances which could be separated by differential elution. The large number of various pigments suggested possible deterioration by heat, so the concentration of the *iso*-butanol extracts was carried out at room temperature. The adsorption of *iso*-butanol extracts prepared in this way on Al_2O_3 revealed the presence of not more than two fluorescent substances. One, F_{2a}, is light amber with purplish-blue fluorescence, weakly adsorbed on Al_2O_3 and quickly eluted by *iso*-butanol or chloroform. The other substance, F_{2b}, is strongly adsorbed on the top of the column; it is green-yellow with silver-blue fluorescence and quickly eluted by methanol. Neither of these fluorescent pigments is present in the original urine or in the neutral potassium chloride eluate, which is non-fluorescent. The fluorescent pigments are formed in the potassium chloride solution from a non-fluorescent precursor on alkalinization. The fluorescence of the alkaline aqueous phase is very slight. The substance causing the fluorescence is extractable with *iso*-butanol and the fluorescence intensity in *iso*-butanol is at least four hundred times as great as in the alkaline aqueous solution. In a number of fluorescent pigments which are soluble both in water and *iso*-butanol the fluorescence intensity in *iso*-butanol is about 1½ to 3 times higher than in the aqueous solution (*cf.* Ellinger and Holden[6]).

The great difference of the fluorescence intensity in water and *iso*-butanol and the extractability of the fluorescent substances from the aqueous phase by *iso*-butanol suggests the presence in water of two forms of the pigment, a non-fluorescent and a fluorescent one; the equilibrium in water is greatly in favour of the non-fluorescent modification, which contrary to the fluorescent one is almost insoluble in *iso*-butanol. Extraction with *iso*-butanol gradually transforms the non-fluorescent modification into the fluorescent one, which is accumulated in the *iso*-butanol.

Differences in *p*H, dependence of adsorption and the finding that the genuine potassium chloride eluate was non-fluorescent and became so by alkalinization excluded the possibility of the identity of F_2 with thiochrome, which cannot be formed from non-fluorescent precursors by alkalinization of a neutral solution.

The analogy with the elimination of trigonelline after nicotinic acid intake suggested the possible formation in the body of N-methyl-nicotinamide by methylation and its connexion with F_2. Two points were against this assumption: N-methyl-chloro-nicotinamide, first prepared by Karrer *et al.*[5], is non-fluorescent and, having a pyridine configuration, can be expected to show an absorption maximum around 260 mμ and not around 360 mμ, as shown for F_2 by Coulson, Ellinger and Platt[2]. Both objections were overcome, the first one by the observation that the



III, IV and V probably fluorescent, soluble in water and *iso*-butanol.

fluorescence of F_2 developed only *in vitro* and the second by the following consideration and its confirmation by the ultra-violet adsorption spectrogram.

The N-methyl-chloro-nicotinamide (I) is non-fluorescent, soluble in water with an absorption peak at 264 mμ and a shoulder at 270 mμ. By alkalinization it forms the probably non-fluorescent quaternary pyridinium base (II) with the same absorption as (I) and an additional small peak at 240 mμ, which in analogy with the findings of Decker and Kaufmann[7] and Hantzsch[8] on alkyl pyridinium bases will change by migration of the OH group into a tertiary carbaminole (III, IV or V). These will be fluorescent. In the aqueous phase the equilibrium favours the quaternary base (*cf.* absorption spectrograms). II is almost insoluble, III, IV, V are soluble in *iso*-butanol. The silver-blue fluorescent F_{sb} might correspond to III or IV, the purplish fluorescent F_{ss} either to V, according to its spectrogram and to Karrer's[6] description of the properties of *p*- and *o*-dihydropyridine derivatives, or less probably be an oxidation product of II or III, since its fluorescence resembles that of the aqueous alkaline solution of I after treatment with potassium ferricyanide.

When N-methyl-chloro-nicotinamide (I), prepared according to Karrer *et al.*[5], was dissolved in water, made alkaline, extracted with *iso*-butanol, adsorbed on Al_2O_3 and eluted with *iso*-butanol and methanol respectively, two compounds were obtained: one of amber colour and purplish fluorescence was eluted with *iso*-butanol or chloroform and another one of green-yellow colour and silver-blue fluorescence was eluted by methanol. They were indistinguishable from the two corresponding urinary compounds obtained in the same manner. The respective ultra-violet absorption spectrograms, the fluorescence concentration curves and the absorption concentration curves for 365 mμ and their reactions to alkali and acid were identical. The purplish fluorescent F_{ss} and the corresponding synthetic compound are comparatively stable to heat and acidification. They have an absorption band in *iso*-butanol with peaks or shoulders at 271, 306 and 347 mμ and an emission band between 438 and 521 mμ and a maximum at 464 mμ. The fluorescence is slightly diminished but not altered in hue by strong acid and not affected by alkali. The yellow silver-blue fluorescent F_{sb} and the corresponding synthetic compound are far less stable, more stable in *iso*-butanol than in methanol, and oxidize by standing in air, particularly when heated. They have an absorption band in *iso*-butanol with a maximum at 358 mμ and a step-out at 268·5 mμ (due to contamination with II?), an emission band between 446 and 549 mμ with a maximum at 500 mμ; acidification with HCl shifts, in both F_{sb} and the synthetic compound, the position of the absorption maximum to 311 mμ. We have not prepared salts of F_2.

The formation of two different fluorescent compounds from the non-fluorescent precursor may explain the variation in hue of F_2 observed in routine assay, which varies from a deep purplish-blue to a light silver-blue.

F_2 appears in urine after the intake of not only nicotinamide but also of nicotinic acid, mono- and di-ethyl-nicotinamide. Ingestion of nicotinic acid and still more of mono- or di-ethyl-nicotinamide produced less and considerably more delayed and prolonged elimination of F_2 than that of nicotinamide (Coulson, Ellinger, Platt[2]). It is apparent that F_2 is formed from N-methyl-chloro-nicotinamide, and this would indicate the formation of an amide from an acid in the body, a process so far as is known without analogy.

Details of this investigation will be published elsewhere. Experiments to determine the structure of the compound are in progress.

To summarize: F_2 is not eliminated as a fluorescent pigment from the body, but formed *in vitro* from a non-fluorescent precursor by alkalinization. F_2 is composed from two fluorescent compounds which can be separated by adsorption on Al_2O_3. Substances so far indistinguishable from them can be obtained by the action of alkali from N-methyl-chloro-nicotinamide.

The authors wish to thank Messrs. Roche Products, Ltd., for the gift of nicotinamide, Dr. Edna Roe for the preparation of the ultra-violet spectrograms, and Miss M. Holden for the fluorescence measurements.

This work forms part of an investigation on nutritional deficiencies being carried out on behalf of the Air Ministry.

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Digestibility of Oatmeal Phytin by Adult Man

McCance and Widdowson[1] found that adult man excreted approximately half the ingested phytin of wheaten flour unchanged in the faeces and that the phytin seriously interfered with the absorption of dietary calcium. It appeared important to us to investigate the availability of the phytin of another staple cereal, oatmeal, in adult man and its influence on calcium absorption.

Calcium, iron and phosphorus balances and the degree to which phytin is hydrolysed within the intestine were determined on four adult subjects. The general pattern of the diet was made to conform, so far as possible under the conditions of the experiment, with that found by Cathcart, Murray and Beveridge[2] to prevail in the Scottish Highlands. To keep the calcium content of the diet low, cheese was eliminated and milk intake reduced. Since the oatmeal intake in the Highlands is lower to-day than hitherto the allowance was increased to bring it closer to that consumed in the Scottish Highlands during the last century[3]. This led to a corresponding reduction in flour intake.

In the first experiment the intake of calcium was 582 mgm. and that of phytin-phosphorus 574 mgm. daily. Almost all the phytin of the diet originated from oatmeal. Only 6 per cent of ingested phytin appeared in the faeces. When calcium lactate supplements were added to the diet phytin excretions increased; when a 200 mgm. calcium supplement was added to the diet the excretion increased to 8 per

cent and, later, when 500 mgm. calcium were added 23 per cent of ingested phytin-phosphorus appeared in the fæces. The increases suggest that the added calcium decreased the solubility of phytin and thus reduced the opportunity for hydrolysis. The percentages of dietary phosphorus voided in the fæces were 34, 36 and 40 during successive experiments with increasing levels of calcium intake. When these phosphorus excretions were corrected for unhydrolysed phytin it was found that phosphorus absorption was within normal ranges. It follows, therefore, that the phosphorus of hydrolysed oatmeal phytin is as available as the non-phytin-phosphorus of a mixed diet.

So far as calcium absorption is concerned our results are inconclusive. To some extent this was to be expected since calcium itself was the variable and, consequently, detection of any influence of phytin on calcium metabolism would be difficult unless such an effect were most marked. The alternative approach of varying the phytin intake by changes in the oatmeal consumption would have introduced a multiplicity of variables. Two of the subjects on the basal diet showed normal absorptions while the remaining two subjects showed subnormal absorptions. In the case of the latter subjects improvement in absorption was associated with increased calcium intake. In the former subjects the addition of calcium lowered absorption somewhat. While these results do not decide the problem of whether oatmeal phytin interferes with calcium absorption, we would like to direct attention to the long-term study of Steggerda and Mitchell[4] who, in experiments designed to determine the calcium requirement of the adult, used a diet of low calcium content in which, incidentally, more oatmeal (284 gm. of oatmeal and oatcakes) was used than in our experiments. Notwithstanding the high oatmeal intake, Steggerda and Mitchell found the daily calcium requirement for equilibrium to be 9·2 mgm. per kgm. body weight, a value agreeing well with those of Leitch[5] of 10 mgm., Mitchell[6] of 9·75 mgm. and Outhouse *et al.*[7] of 10·7 mgm. Further, recalculation of the data of Steggerda and Mitchell shows that in their experiments calcium absorption was not interfered with by the phytin of oatmeal.

The absorption of iron was higher than that found by Widdowson and McCance[8] for subjects consuming brown bread diets.

The results reported in this note strongly suggest that the digestibility of phytin, and therefore probably its effect upon the absorption of minerals, varies from cereal to cereal.

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Supplies of Crystalline Vitamin D_3

IN 1936, Windaus[1] and his co-workers isolated from the irradiation products of 7-dehydrocholesterol a dinitrobenzoate identical with the ester prepared almost simultaneously by Brockmann[2] from a concentrate of tunny fish-liver oil. The hydrolysates of these esters, though yielding no crystalline alcohol, clearly consisted of vitamin D_3 approaching purity. The crystalline vitamin itself was first prepared by Schenk[3] in 1937 from the irradiation products of 7-dehydrocholesterol. This isolation was described more fully by Windaus, Deppe and Wunderlich[4] in the same year. The same crystalline vitamin was prepared[5] in the following year from fish-liver oil.

A few grams of crystalline vitamin D_3, of German origin, became available in Great Britain before the War, for experimental work on animals[6] and man[7,8,9]. It was then clearly shown that clinically and in rat assays there was no significant difference between the antirachitic or hypercalcæmic activities of vitamins D_2 and D_3. The very limited quantity remaining after the completion of these experiments was set aside as a British Standard for vitamin D_3 (chick tests); since 1939, no further quantity of crystalline D_3 has been available in Great Britain.

During the last decade in these Laboratories we have had fairly extensive experience of the isolation and purification of calciferol, both on the laboratory scale and on the relatively large scale of fine chemical manufacture. During the last four or five years frequent, if intermittent, attempts have been made by us to apply these methods to the isolation of pure vitamin D_3. Even the addition of seeds of the German sample mentioned above failed to yield us any crystalline material.

It is only during the past few months that the matter has been attacked again more systematically, and we have now been able, after rigorous purification of the dinitrobenzoate, to produce several small batches of crystalline material that undoubtedly consists of vitamin D_3. One of these batches has been submitted to biological assay, and was found to have an activity slightly greater than, but not significantly different from, 40×10^6 I.U. per gram when assayed on rats by the usual line test procedure. All the batches had physico-chemical constants substantially the same as those claimed by the German investigators for the pure crystalline material.

We hope to prepare a series of larger batches, and to make a study of their physico-chemical constants, as well as of their biological activity, with the view of laying down a specification for the pure crystalline vitamin. Meanwhile, the small quantities of material at present in hand are available for research purposes and we should like this to be known to all workers in the vitamin field.

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Fermented Liquors in Old-time Cooking

THE riboflavin value found in ancient buns and ale (see NATURE, September 4, pp. 273–274) has an interesting historical background. Few people realize to-day the extent to which our ancestors used fermented liquors for all manner of domestic purposes.

Out of 516 early English recipes[1] (A.D. 1430–1450), ale, vinegar and wine are given as ingredients 306 times, often two or all three together and in considerable quantities. Barm and yeast (the latter presumably yeast strained from barm) were also used, apart from their normal function in bread and cakes. Fish was almost invariably cooked in ale, vinegar or wine, and mutton was stewed with all three.

In preparing "Mawmene"[2], a mixture of finely shredded pheasant, partridge and capon, often with the addition of pork or veal, wine was added six times, vinegar twice and ale once. The dish was not so alcoholic as it sounds; it was cooked for some time and most of the spirit would evaporate, but what subsidiary food factors were left behind?

The sauces used by our ancestors had a base of crumbled bread mixed with wine, or vinegar, and flavoured with salt, pepper, mustard, cinnamon, cloves and other spices, and many of their meat dishes were sweetened with honey or sugar comfits. Relics of these are our bread sauce with game, red currant jelly with mutton and apple sauce with pork.

A recipe of Sir Kenelm Digby (A.D. 1669)[3] for stewing rump of beef says, "and put upon it about two quarts of good strong deep well bodied claret wine". The gravy must have been rather nice! Sir Kenelm also used elder vinegar with turkey, capon, hare, pigeon and veal, and for fattening chickens recommends that their food should be mixed with ale and adds, "and let them have strong ale to drink".

At about this same period Hannah Woolly[4], a 'domestic science' expert of her time, guaranteed to cure scurvy by steeping scurvy-grass, wormwood, horseradish, red-dock root and various other herbs in five gallons of ale, the patient to drink a pint night and morning—approximately a three weeks course. It would be interesting to know the ascorbic acid value of that mixture.

Hannah Glasse[5] (A.D. 1747) used port and sherry on all possible occasions, stewed her steak in ale and, in a chapter headed "For Captains of Ships", gives a recipe for mushroom catchup to keep twenty years, which starts "Take a gallon of strong stale beer. . . ."

In the early eighteen hundreds, pickled herrings were still a national dish, great quantities were eaten, and there was a thriving Scottish trade in salmon pickled in vinegar, which was exported to the growing industrial towns of the south[6].

These delectable habits died rapidly during the second half of the nineteenth century. Quick transport from the developing railways, the drift of population to the towns during the Industrial Revolution, the growth of vast suburbs with cramped kitchens (later to become our slums), the invention of canning plus the demand of an industrial people for ready prepared foods, most of all, possibly, the ever-increasing excise on fermented liquors and the decline of home brewing—all these played a part in the change.

Whether the result has been for the nutritional benefit of the nation as a whole is open to grave doubt.

H. S. SARSON.

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[1] Austin, "Two Fifteenth Century Cookery Books" (Early English Text Society, 1888).
[2] Harleian MS. 4016. "Here Beginnethe a Boke of Kokery".
[3] "The Closet of Sir Kenelm Digby, Opened" (1669).
[4] Woolly, Hannah, "The Queenlike Closet" (1670).
[5] Glasse, Hannah, "The Art of Cookery made Plain and Easy" 1747, and later editions).
[6] Beaufoy pamphlet, *circa* 1820.

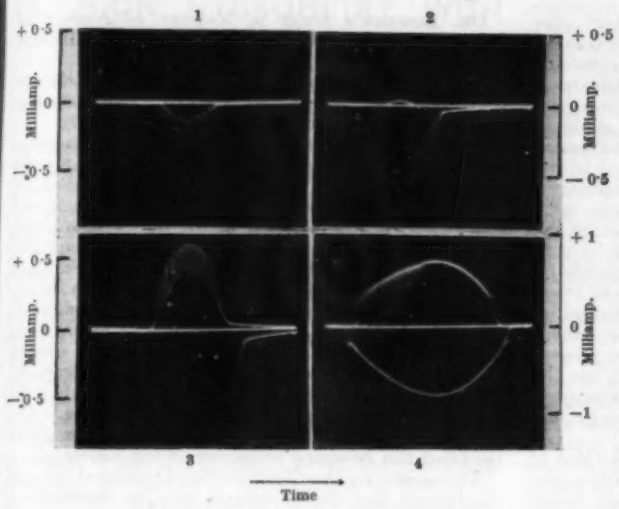
Initiation of Glow Discharges

THE form of the breakdown voltage/pressure curve for various gases in the pressure range 0–5 cm. mercury has been established by several investigators. The breakdown voltage usually measured is that at which a galvanometer in series with the experimental tube indicates a current of 0–1 microamp. This current increase is usually so abrupt (Druyvesteyn and Penning[1], p. 105, and Fig. 16) that the corona-starting voltage is defined within a range usually smaller than the accuracy of measurement. Huxley[2,3], Penning[4], Bruce[5] and Boulind[6], among others, have studied He,Ne[2] and N_2[3], A,He,Ne[4], H_2[5], and O_2, CO_2, H_2 and air[6].

There has been little published work dealing oscillographically with the breakdown processes at these pressures[7] (less than 5 cm. mercury). Considerable information is available for air at atmospheric pressures[8,9,10], and more recently, after our own experiments were started, data have been obtained for He, N_2 and A[11] at pressures down to 10 cm. mercury.

Owing to the present circumstances, the time available for our studies has been limited, and the gases used (H_2, N_2, O_2, A, Ne, CO_2, CH_4, air and CCl_2F_2) have usually been of commercial purity. Mercury contamination has been carefully avoided. However, the results obtained with these gases have been so varied and reproducible that some conclusions may be drawn for the pressures less than 3 cm. mercury. Also, the use of alternating current (50 c.p.s.), which is unusual in work of this kind, has been found advantageous and has led to certain improvements in technique. Other earlier workers[12,13] have used A.C. in corona studies carried out before modern methods were applied in this field. Care must clearly be taken in the interpretation of the results, so that effects due to the A.C. are not attributed to discharges in the gases. The A.C. results have, therefore, been checked frequently with D.C., and it is unlikely that any but very minor effects are due to the use of A.C. However, the persistence of metastable atoms in argon apparently causes small currents to flow during the positive half-cycles if appreciable currents are established during the preceding negative half-cycles. This causes the A.C. peak breakdown voltages in argon to be consistently less than the corresponding D.C. breakdown values, whereas in the other gases, the A.C. and D.C. breakdown voltages are identical, within the limits of experimental error. In accordance with the earlier work[4], negative breakdown precedes positive breakdown at the smaller electrode; the only exceptions we have found are oxygen and air at certain pressures in the counter, again confirming established data[6].

The use of a two-beam oscillograph, which allows



simultaneous observation of tube current and either tube voltage or a timing wave, has been found to be of great assistance.

Figs. 1–4 show the results for O_2 (~ 0·5 per cent N_2) at a pressure of 1·5 mm. mercury and a temperature of approximately 20° C. in a Geiger counter the copper cylinder and tungsten wire diameters of which were respectively 2·5 cm. and 0·127 cm. The resistance in series with the tube was approximately 1·9 megohms, except for Fig. 4, where it was 1·1 megohms. Variation of this resistance has often a considerable effect on the nature of the corona phenomena, as would be expected. Figs. 1–4 were taken respectively for tube voltages of 560, 640, 735 and 1,200 peak volts. At the lowest voltage only negative corona is present, in the form of negative streamers which, as the voltage is raised, eventually give place to a steady conducting state, in this case a self-maintained glow discharge. Positive corona appears initially as a continuous discharge (Fig. 2); positive streamers develop at higher voltages and are finally succeeded by a glow discharge (Fig. 4).

In some cases, streamers occur at breakdown and persist for an appreciable range of voltages. It would appear[14] that many of the authors cited above had made no allowance for this possibility in calculations involving the use of steady current values.

These experiments will be continued and extended, as circumstances permit, although it is inevitable that progress will be slow. It is hoped in particular to study the discharge in carefully purified gases and, extending Weissler's results, to observe the effect of the addition of quenching agents to gases in which metastable states appear[11]. Interesting features of the discharge centre round the Paschen minimum, where the effect of electrode materials will no doubt be important, and this region requires to be investigated further. The transitions between the various forms of the discharge, for example, from the streamer to the continuous glow, all require a closer investigation, and this will, of course, necessitate a careful study of the effect of the circuit parameters. Then, in addition to the low-pressure observations, it is hoped to observe the discharge effects at high gas pressures, in excess of atmospheric, some results for which have been obtained by Pollock and Cooper[15].

One of the valuable features of work on corona is the contribution to the better understanding of the fundamental processes which govern the propagation of discharge in gases and, in particular, photo-ionization. Such knowledge is necessary for the interpretation of many discharge phenomena, such as the spark, the mechanism of streamer development, and Geiger counter action.

Among other investigations which are of direct practical use to the engineer, and which we hope to continue, is the study of corona in various types of engineering apparatus, where corona may take place either in a gas, liquid or solid dielectric. Similar work on the onset of ionization has been reported by Quinn[16].

We are indebted to Dr. A. P. M. Fleming, director of the Research and Education Departments, Metropolitan-Vickers Electrical Co., Ltd., for permission to publish this note.

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Aug. 24.

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Future of Technical Colleges

WE have read with interest the communications by Mr. E. B. Moullin[1] and Dr. H. Lowery[2], which comment upon our letter[3] on this subject. These letters fail to offer further constructive suggestions, and we therefore focus attention again upon some essential and immediate needs of technical education, particularly in the advanced sphere, and upon a scheme for their fulfilment. We would urge that so far as possible, discussion should be concrete and definite. It is not enough to speak vaguely of ideal systems, people's university, etc., without specifying what is meant, or how to attain this ideal.

It has been contended that[3] in relation to the total number of students receiving technical education, there are not many who require advanced training in applied sciences, technology and commerce. The *absolute* numbers, however, are not small, and are steadily growing. In the present chaotic organization of technical education, whereby both advanced and elementary students are frequently housed in the

same college, the great numbers of elementary students statistically outweigh the advanced students. Imagine the same system to operate in the university sphere, with elementary education and also advanced academic studies in the same building. From the point of view of numbers, the elementary students would again numerically far outweigh the advanced students. In fact, in the technical colleges as in the universities, and for the same reasons, the advanced work is of vital importance. We would again urge the creation of higher technical colleges in which the advanced work at present in existence may be concentrated. The major colleges might be fed partly by satellite colleges, and also by technical schools, evening institutes and schools, just as the universities are now fed by the high schools, grammar schools and public schools. The advanced work at present done by the technical colleges, particularly on the research side, is inadequate; but with the suggested arrangement a growth of advanced technology and research becomes possible.

The new higher technical colleges, or institutes of technology, functioning along these lines, with generous financial backing by the State and, we would hope, by industry, have a vital part to play in maintaining the place of Great Britain as an industrial country. We would again point out, since this great but remediable weakness in our technical education system has not been emphasized sufficiently, that the apex of technical education, as understood in America and the Continent, and exemplified in their institutes of technology and *technische Hochschulen*, is almost entirely lacking in Great Britain. One reads, moreover, that Britain spends only a very small fraction *per caput* of the American and Russian expenditure on technical education. To hold our own in post-war industrial development requires great and unremitting efforts on our part. Nowhere can we begin better than by sorting out our technical education system, concentrating the various grades of work in appropriate institutions, and by creating some institutes of technology on the American pattern.

We are loth to make an issue of external examination systems. As a means of obtaining high qualifications in technology, we believe that the external degree system has rendered important service to Great Britain, whatever has been said to the contrary by those who disparage degree work in technology in the technical colleges. We make the further comment that before the external degree could be displaced it would be essential that an internal examination *accepted nationally by industry and commerce* as giving qualifications at least of equal standing should be *actually in existence* to take its place. We know of no such examination which is even remotely able to substitute for the external degree examination in giving an all-round qualification in the various applied sciences. One can therefore see that any attempt to suppress this system constitutes a serious threat to training in advanced technology in technical institutions. This threat comes, moreover, at a time when we should be making every effort to expand and develop all branches of technical education, particularly the advanced work.

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J. P. ANDREWS.

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[1] NATURE, 152, 191 (1943).
[2] NATURE, 152, 218 (1943).
[3] NATURE, 152, 80 (1943).

DR. LOWERY'S letter in NATURE of August 21 contains several statements which cannot be allowed to pass unchallenged.

Referring to degree courses, he writes, "It is not right, however, that the coaching of a relatively few people for examinations run by an outside body . . . should come to be regarded as the highest function of a technical college and should unduly influence its educational aims". I am quite certain that, in general, it is not so regarded either by technical colleges or by the members of the public who know of their work, and the implication that this small volume of work unduly influences the educational aim of colleges is quite incorrect. Further, he states, "Degree courses in technical colleges are makeshift courses", but Dr. Lowery is quite well aware that there are many technical colleges where the degree courses are not makeshift courses but are properly organized courses conducted by staff, and with equipment, not inferior to some universities. Dr. Lowery should in fairness to these colleges have qualified the sweeping character of his statement.

The question of the desirability of technical colleges conducting any degree courses may be debatable—though the real debatable point is should there be such a thing as an external degree—but to imply that technical colleges are "tending to neglect their most important work" partly as a result of "flirting" with university education is to convey a wholly misleading picture of the technical colleges in Great Britain. The splendid work of these colleges, related directly as it is to the needs of industry, has been a factor of the greatest importance in our industrial development.

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THE attention of the Council of this Association has been directed to a letter from Dr. H. Lowery which appeared in NATURE of August 21, p. 218. In this the writer states that: "Degree courses in technical colleges are makeshift courses, and have grown out of a makeshift system".

While it is true that these courses have grown, as indeed the universities have themselves, from small beginnings, the statement that the degree courses in the technical colleges of Great Britain are makeshift is quite untrue and a damaging statement as regards many important colleges in both London and the provinces.

In London, several of the polytechnics are recognized for *internal* degrees of the University of London in a number of subjects. Actually, about 44 per cent of the students who obtain the internal degrees in engineering carry out their courses in polytechnics and not in the University itself, while in science the percentage is about 27.

There are also a number of well-equipped and adequately staffed technical colleges in the provinces which have been carrying on degree courses successfully for many years. These courses are in every way as satisfactory as those in the universities themselves.

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D. HUMPHREY.
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PRECISION HYGROMETRY WITH A WET-BULB

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A METHOD was required whereby the relative humidity (R.H.) of air in equilibrium with cotton samples could be determined to one half of one per cent. The apparatus had to maintain its zero and its calibration year in and year out, so as to make it suitable for routine employment in a testing laboratory. Certified thermometers which are used within the limits of ordinary room temperature changes can fulfil this condition, so the wet-and-dry-bulb method was investigated and improved until it became precise. So far as cotton-testing is concerned, the work is at present in suspense, but the wet-bulb hygrometer was tried out during a couple of years and seems to merit description.

The following are the essential components. An aspirator, which is a diaphragm-type variable speed air-pump, is required if re-circulation of the air is needed. The temperature of the air at the sampling point is noted by a thermometer mounted with its bulb concentric to the intake of the aspirator. This air then passes through a long coil of copper tube immersed in a water-bath, where it comes to the temperature of the water and so almost stabilizes the next reading to be taken, that of the dry-bulb proper; incidentally, this minimizes reading errors on the dry-bulb. This partial stability is only due to the large volume of the water-bath (about ten litres), its temperature not being regulated at all; obviously, if its temperature is below the dew-point of the incoming air, warm water must be used. The wet-bulb and dry-bulb thermometers are mounted inside two vertical and parallel glass encasing tubes, sealed below and stoppered at the top, with side-tube inlet, side-tube exit, and a side-tube connexion between them. The lower ends and the side-tubes are all immersed in the water-bath, thereby helping to screen the thermometer bulbs from external radiation. Air coming from the copper pipe impinges on the dry-bulb at right angles through the inlet tube, then passes through the interconnecting tube; cemented inside this is a stainless steel liner which standardizes its diameter and hence the rate of flow at which the air impinges on the foot of the wet-bulb in the other encasing tube. The air escapes from the latter through the exit side-tube, which is similarly lined, but with a stainless steel tube of slightly smaller diameter; thus a small air pressure is built up in the wet-bulb encasing tube; this exit tube is aligned to withdraw the air from the top of the wet-bulb wick, so giving very turbulent air-flow over the wick at a known final velocity; actually six metres per second is used. The volume of air passed through or around the circuit is indicated by a venturi throat inserted therein with an inclined mercury manometer attached; this is calibrated by direct collection of the air discharged and adjusted by inclining the manometer so that a single marked point thereon indicates six litres per minute in our particular lay-out; if the reading is off this marked point, the pump-speed is regulated accordingly.

Certain precautions are taken in the use of these essential components. The encasing tubes and venturi meter are enclosed in a glass-fronted cupboard resting on top of the water-bath tank; the roof of the cupboard is hinged for access to the encasing tubes. Thermometers of the sling-psychrometer type are used, with small cylindrical bulbs, taking less than two minutes to reach equilibrium; the lapse of this time is most conveniently indicated by using a sand-glass, to avoid confusion of thermometer figures with clock figures in rapid working. This type of thermometer was more easily obtained in Fahrenheit calibration, and is read to estimated tenths of a degree Fahrenheit in order to get the accuracy required; this is done by simple lenses in anti-parallax mountings, which slide on the glass cupboard-front. It having been found that confusion was liable to happen between tens and fives on the scale of degrees when reading through lenses, the thermometer stems were painted red from 65 to 70, 75 to 80, and so on. A very convenient standard wick was adopted by removing the braided cotton cover from electric wiring flex of suitable size; this was boiled in caustic soda and washed with distilled water while stretched on glass tubing of the same diameter as the thermometer bulb; after drying, it was cut into lengths slightly longer than a bulb, slipped on the bulb and slightly stretched to make it hold closely.

With the apparatus thus set up, and using appropriate tables or graphs, we first obtain the 'grams of moisture per kilogram of air' from the depression of the wet-bulb, and then refer this to the temperature of the intake thermometer, so finding the relative humidity at the intake. The standard error of the determination is dependent on reading the thermometers to one tenth of one degree, and so is greater with damp cold air than with hot dry air; this error can be reduced by using a warm water-bath, and in average conditions is less than ½ per cent R.H. The absolute accuracy of the result, as distinct from the relative accuracy with which we were immediately concerned, is necessarily contingent on the accuracy of the tables of hygrometry. In the last resort, these should be worked out anew for the particular instrument design employed, with the correct air-speed.

However, the lay-out described, though completely standardized, can only be effective if the evaporating abilities of the wick itself are also standardized, and the technique whereby the wick-properties are stabilized over periods of a year and more constitutes our principal improvement in wet-bulb hygrometry. It has been noted by meteorologists that wet-bulb wicks deteriorate during use, the depression becoming less than it should be. This had been ascribed to dust and dirt adhering to the wick. A weekly change of wick is routine in some meteorological screens. Using our apparatus under the very stringent conditions of cotton-air-moisture determination checked against actual oven-tests, on many samples every day, we found at first that a weekly change of the wick sufficed. But this was during the winter, in Alexandria, and as the observations continued into the hot weather we found evidence of wick deterioration arriving more rapidly, until by June the results were falsified even by the second day of use. This suggested a biological factor in the deterioration.

The encasing tube of the wet-bulb thermometer was therefore expanded into a biggish bulb at the bottom, this bulb being completely immersed in the water-bath, and itself filled with a 0·1 per cent solution of mercuric chloride, as an antiseptic against bacteria and fungi, which nevertheless was so dilute as not to behave unlike pure water during short runs. The

stopper at the top of the encasing tube was expanded into a glass saucer, closed by a thin and slack rubber diaphragm from toy balloons. The wet-bulb thermometer was suspended from this diaphragm with appropriate stops to limit its range of up and down movements. Normally it remained with its bulb immersed in the mercuric chloride solution. When the air-pump was started the small pressure built up in the encasing tube caused the diaphragm to distend; this lifted the thermometer with its dripping wet wick into the turbulent air-flow and held it steady in position ready for reading after two minutes had elapsed. The wicks used will hold the depression constant for some five minutes or more, according to conditions, before they show signs of drying up. The evaporation from the solution is negligible except while the air-stream is flowing, and it is then of the order of three milligrams of water per test, so that the solution has eventually to be topped up with distilled water; actually about once a week when in continuous daily use. The relative humidity of the outgoing air is perceptibly increased by this added water, which is immaterial unless re-circulation is employed, when small corrections become necessary, dependent on the volume of air in the system.

The stability of the system over long periods of time, and its low standard error, are its outstanding advantages. Its accuracy would seem to be of the same order as that of the more difficult dew-point determinations. Additionally, it is often very convenient to be able to place the intake in some particular locality, with a long rubber tube to the apparatus, and examine the humidity in different parts of a room, or underground in the soil, and so forth.

ROYAL PHOTOGRAPHIC SOCIETY'S ANNUAL EXHIBITION

THE eighty-eighth Annual Exhibition of the Royal Photographic Society of Great Britain was opened on September 3 by H.R.H. King Peter of Yugoslavia. The Exhibition is being held at the Society's premises at 16 Princes Gate, London, S.W.7, and will be open to the public between 10 a.m. and 5 p.m. until October 23 inclusive. A new experiment being tried this year is Sunday opening. The Exhibition is being opened on alternate Sundays, September 12 and 26 and October 10 from 2 p.m. until 5 p.m. This is to enable members and others who, on account of their war work or other causes, are unable to travel or find time to see the Exhibition on weekdays.

The Exhibition, as is usual, covers all branches of photography from the purely pictorial to the use of photosensitive material in research. While one cannot but admire some of the pictorial work and note that both the quantity and quality of previous years seem well maintained, one can regret that the same cannot be said of the 'scientific' exhibits. The best represented section is probably "Natural History", in which are shown many fine examples of wild life (both plant and animal) in their natural habitats. The War has evidently had little effect on the patience of the photographer of Nature.

Colour photography also seems to have suffered little, being represented by a number of prints on paper some of which are of excellent quality. Many transparencies are shown, including one case of "Scientific Colour Transparencies" which are mainly of biological subjects, or photomicrographs by polarized light.

Of special interest this year are two exhibits in the Trade Section. One is on mass miniature radiography by Ilford Limited and the other on the 'Kodak' transfer sensitizing process. The attack on tuberculosis depends for its success on early diagnosis, so that the possibility of mass miniature radiography should be a milestone on the road to the control of the disease. In the absence of means of refracting or specularly reflecting X-rays it has been generally necessary to obtain full-size pictures of the subject. Quite apart from the cost of such large photographs as are necessary when dealing with the human chest, the handling of large numbers of 15 in. × 12 in. films becomes a serious matter. The possibility of photographing, with an ordinary camera and film sensitive to light, the fluorescent image produced by X-rays falling on a fluorescent screen was shown many years ago, but it has only relatively recently been possible to reduce this process to one of routine requiring only a short exposure of the patient to X-rays. This development has been due largely to the increase in aperture of lenses and the increase in speed of photographic film. The image of the chest is contained in an area of film only one inch square, so that a large number can be accommodated on 35 mm. cine-film which can be easily handled in any length.

Mass miniature radiography units have been developed and have been adopted by the Ministry of Health for national service purposes. The equipment and method of working is illustrated in detail by pictures and models. It must be emphasized that the method is not intended as one for diagnosis but to enable a large number of presumably normal individuals to be examined to detect unsuspected abnormalities which can, where necessary, be the subject of full-scale radiological and clinical examination.

The exhibit by Kodak Limited is of the 'Kodak' transfer sensitizing process by means of which any flat sheet material can be sensitized. The chief application is in the marking of templates. The conventional method consists in hand-scribing the design from a scale drawing, which requires a skilled and experienced operator. By the method illustrated the material on which the template is to be marked is first lacquered and the sensitizing paper is then squeegeed to it by means of a roller squeegee. The temporary paper support is stripped off when the sensitive surface is required for use. The required design may be drawn on translucent paper, or should the original drawing be on an opaque support an intermediate negative is necessary or the 'reflex transfer' process may be used. The exposed layer is then developed on the metal or other support to yield an image of the required design.

The process is illustrated by a series of specimens contributed by Handley Page, Ltd., including an 8 ft. × 4 ft. metal section bearing designs reproduced by this process.

The process also lends itself to the production of such things as name-plates, instrument dials, etc. Direct use may be made of the photographic image, but more robust forms may be made by converting the image into a gelatin stencil which allows the undercoat lacquer to be dissolved away, leaving the design in lacquer, or the bared metal may be plated or etched and filled. Typical examples of this applica-

tion are shown by Marconi Instruments, Ltd., and The Accurate Recording Instruments Co.

Having dwelt at some length on only two of the exhibits may give the impression that there is little else to be seen. This is not so. The pictorial prints, lantern slides and stereoscopic transparencies are themselves worth a visit and can be relied upon to provide agreeable relaxation.

A SURVEY OF CANADIAN SCHOOLCHILDREN

THE statistical results of a survey of children in the elementary schools of the city of Toronto, taken in November 1939, have recently been published*. It is a team work in which the Hospital for Sick Children in Toronto, the Department of Pensions and National Health, Ottawa, the Education Statistics Branch of the Dominion Bureau of Statistics, and the Toronto Board of Education participated. The whole report is the work of Mr. N. Keyfitz and his assistants of the Social Analysis Branch of the Dominion Bureau of Statistics.

In 1923 the Department of Public Health in Toronto made a survey of 59,000 elementary pupils, from which a table of average heights and weights by age was calculated and which became the standard for Canadian school-children. During the intervening sixteen years it was found that, as a result of the policy of social improvement based on the previous findings, pupils in the various age-groups were outgrowing their categories, and it was decided to institute a new survey in which medical investigation would be as thorough as possible and the correction of physical defects would be a major aim.

In the present study of 78,000 children, equally divided on the basis of sex, emphasis is laid on the influence of such factors as economic status, birthplace of parents and the range within which nutrition affects the build of children. An effort is made throughout to determine the relative importance of the following points: (1) Does the economic status of the family influence the prevalence of disease and defect? (2) Does it retard the child in his academic standing as indicated by his school grade? (3) Do certain combinations of defects or diseases have more effect on the height and weight than the same defects and diseases unassociated? (4) How does heredity as shown by parental birth-place affect build?

The pupils of 1939 are found to be taller for their age than similar groups of 1923, except the six-year-olds. This may be explained by the fact that it is now customary to enter children at school at six, while formerly less robust six-year-olds were kept at home. Girls are found to mature earlier than boys; but thirteen-year-olds of the latter are found to mature at two different rates, as shown by a bimodal distribution representing maxima in height and weight combined.

An interesting comparison between the Toronto survey and Sir Frederick Menzies's London survey of 1938 is made. Canadian children, as one would expect, are taller than English ones. The London children of 1938 approximate in height and weight the 1923 levels of Toronto. However, the differences between the well-to-do and poorer metropolitan boroughs show the same tendencies as the Toronto ones, the differences being, if anything, less marked in England. A similar extensive study by the U.S. Department of Agriculture (Garment and Pattern Construction) in 1941 of 147,000 white schoolchildren of 4–17 years of age is remarkably close to the Canadian figures.

Economic status of parents: It is found that unskilled labourers and unemployed parents have children who are under-height; but there is striking absence of differences in build, that is, weight in relation to height, between children from poor and prosperous districts.

Diseases and defects: Diseases have no appreciable effects on height and weight, but defects tend to make their owners shorter and lighter for their height, that is, thinner.

Heredity: Children of United States-born parents are taller, and those of British-born parents are lighter than those of Canadian-born parents. Inter-racial marriage tends to increase the height of offspring. Children whose parents are eastern European-born are taller and those whose parents are of western European birth are shorter and heavier.

It is, of course, well known that foreign-born immigrants tend to be in less skilled occupations, while United States-born are often in a higher economic level than the Canadian-born.

The work is lavishly illustrated with charts and tables but one feels, after all is said, that fewer tables and a more detailed discussion of the biological principles governing growth would make this excellent booklet more valuable and instructive. Nevertheless, in these days when the very basis of science is being challenged, and men of science are everywhere engaged on the destructive aspects of their calling, it is refreshing to come across a progressive little book of the type, at once creative and far-sighted.

R. E. G. ARMATTOE.

* A Height and Weight Survey of Toronto Elementary School Children, 1939. Pp. 36. Published by authority of the Hon. James A. MacKinnon, M.P., Minister of Trade and Commerce. (Ottawa, 1942.) 25 cents.

RADIO DETECTION AND RANGING

'RADAR', the code name for radio detecting and ranging, has been officially revealed to be one of the foremost scientific developments of the War, according to a statement issued by the Western Electric Co. (*Bell Lab. Rec.*, **21**, No. 10; June 1943). An electronic instrument projects a beam of radio impulses, and these impulses reveal the presence of distant objects by rebounding to the observer. When trained on enemy aeroplanes, still so distant as to be beyond the reach of anti-aircraft guns, 'radar' reports their presence. The system is, of course, unaffected by darkness, clouds or fog.

Under the name of radiolocation the method was credited by Lord Beaverbrook with winning the Battle of Britain. In the South Pacific, according to the article in the *Bell Laboratories Record*, it has been responsible for enemy losses of millions of dollars' worth of ships, aeroplanes and submarines. Radar was developed on the basis of years of research and experiment in electronics, independently in the United States and Great Britain, and credit for the development must be shared by many of the foremost scientific men of the two nations.

The fact that radio waves can be reflected just as

can light and sound waves had long been known and the phenomenon had been used, for example, to measure the electrical reflecting surface in the ionosphere. Only with the advent of the ultra-short radio waves in the early 1930's did it become possible to observe reflexions from objects so small as an aeroplane. In 1932, it was noticed that an aeroplane flying about 1,500 ft. overhead produced a noticeable 'flutter' of about four cycles per second. In 1938 the absolute altimeter was introduced commercially for use in aircraft. This instrument employed the principle of directing radio waves against the ground and timing their return to give the exact height of an aircraft above the earth. In the same year, in the United States, a series of experiments at 15th Street in Brooklyn overlooking the Narrows leading into Manhattan's upper bay was made, using a modification of the absolute altimeter enclosed in a hornlike directional antenna system of galvanized sheet, and it was observed that radio waves directed against ships passing through the Narrows were thrown back into the receivers.

With the formation in the United States of the National Defense Research Committee, 'radar' became one of the most active lines of investigation by a large group of scientific workers. A mission of British men of science to the United States made a complete disclosure of the status of their art, with reciprocal disclosures by the N.D.R.C. group. Still in limited use in the U.S. Armed Forces when the United States entered the War, 'radar' is now standard equipment for both American Army and Navy. An official statement says of it, "radar is used by static ground defences to provide data for anti-aircraft guns for use in smashing Axis planes through cloud cover, and by airplanes and warships".

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public.)*

Saturday, October 2

ASSOCIATION OF SCIENTIFIC WORKERS (at Essex Hall, Essex Street, Strand, London, W.C.2), at 2.30 p.m.—Conference on "Problems of Freed Europe—The Challenge to the Medical Sciences". Problems of the Occupied Territories: Belgium (Dr. A. Marteau); Czechoslovakia (Dr. V. Kruta); Greece (Dr. A. P. Cawadias); U.S.S.R. (Prof. S. A. Sarkisov); Present Plans for Relief (Prof. J. R. Marrack).

GEOLOGISTS' ASSOCIATION (at Geological Society, Burlington House, London, W.1), at 2.30 p.m.—G. S. Sweeting: "Wealden Iron Ore and the History of its Industry".

Monday, October 4

SOCIETY OF CHEMICAL INDUSTRY (LONDON SECTION) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. S. J. Johnstone: "The Organisation and Use of Technical Intelligence Services".

Tuesday, October 5

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. Margaret Mead: "Modern Anthropology".

CHADWICK PUBLIC LECTURE (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Mr. E. J. Boome: "Muscular and Mental Relaxation in Peace and War".*

SOCIETY FOR THE STUDY OF INEBRIETY (in the Meyerstein Lecture Hall, Westminster Hospital Medical School, Horseferry Road, London, S.W.1), at 4 p.m.—Dr. A. Ninian Bruce: "Alcohol and Avitaminosis" (Nineteenth Norman Kerr Memorial Lecture).

SOCIETY OF CHEMICAL INDUSTRY (MANCHESTER SECTION) (Joint Meeting with the MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY) (in Room 7, The University, Oxford Road, Manchester), at 5.30 p.m.—Sir John Russell, F.R.S.: "Agricultural Reconstruction in Europe after the War".

Thursday, October 7

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Colonel Sir A. Stanley Angwin: Presidential Address.

Friday, October 8

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Mr. H. W. Newton: "Solar Flares and Magnetic Storms".

Saturday, October 9

SHEFFIELD METALLURGICAL ASSOCIATION (Joint Meeting with the MICROCHEMICAL SECTION OF THE SOCIETY OF PUBLIC ANALYSTS and the SOUTH YORKSHIRE SECTION OF THE ROYAL INSTITUTE OF CHEMISTRY) (in the Department of Applied Science, The University, St. George's Square, Sheffield), at 2.30 p.m.—Symposium on "Microchemical Analysis".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

CHAIR OF SOCIAL MEDICINE—The Secretary, The University, Edmund Street, Birmingham 3 (March 1).

UNIVERSITY LECTURER IN ANTHROPOLOGY—The Secretary of the Appointments Committee of the Faculty of Archæology and Anthropology, Museum of Archæology and of Ethnology, Cambridge (April 15).

HEAD OF THE DEPARTMENT OF DYEING in the Bradford Technical College—The Director of Education, Town Hall, Bradford (October 9).

LECTURER IN PHYSIOLOGY AND ZOOLOGY—The Registrar, Technical College, Sunderland (October 9).

LECTURER (WOMAN) IN BIOLOGY in the Department of Pharmacy and Biology—The Principal, Central Technical College, Suffolk Street, Birmingham 1 (October 9).

EDUCATIONAL PSYCHOLOGIST—The Chief Education Officer, Education Office, Warrior Square, Southend-on-Sea (October 11).

RESEARCH HISTOLOGIST (NON-MEDICAL) in the Pathological Department—The Secretary, Royal Cancer (Free) Hospital, Fulham Road, London, S.W.3 (October 13).

TEACHER OF MATHEMATICS AND PHYSICS in the Junior Technical School and Senior part-time Classes of the Batley Technical College—The Director of Education, Education Offices, Batley, Yorkshire (October 15).

ASSISTANT ELECTRICAL ENGINEER for the Nigerian Government Public Works Department—The Secretary, Overseas Manpower Committee (Reference No. 538), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2.

ASSISTANT MECHANICAL ENGINEER FOR THE ELECTRICAL BRANCH of the Nigerian Government Public Works Department—The Secretary, Overseas Manpower Committee (Reference No. 1076), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2.

MECHANICAL AND ELECTRICAL ENGINEER for the Gold Coast Government Public Works Department—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, "D" Section, D.588X, Alexandra House, Kingsway, London, W.C.2.

ENGINEER AND MANAGER of the Inverness Corporation Electricity Department—The Town Clerk, Town House, Inverness (October 11).

ASSISTANT MASTER TO TEACH SCIENCE, with an Engineering bias, and PRACTICAL MATHEMATICS, in the Forest of Dean Mining and Technical School and East Dean Grammar School—The Secretary, County Education Office, Shire Hall, Gloucester.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Section B (Biology). Vol. 61, Part 4, No. 30: Study of an Introduced North American Freshwater Mollusc, *Stagnicola catascopium* (Say). By D. Keith McE. Kevan. Pp. 430–461. (Edinburgh and London: Oliver and Boyd.) 2s. 9d. [308

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 15: The Chemical Constituents of Lichens found in Ireland—*Lecanora gangaleoides*, Part 3: The Constitution of Gangaleoidin. By Dr. V. E. Davidson, Dr. J. Keane and Dr. T. J. Nolan. Pp. 143–164. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 2s. [308

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1943 June 5. Pp. 14. (Greenwich: Royal Observatory.) [308

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 158: The Recovery of Inter-Block Information in Quasi-Factorial Designs with Incomplete Data, 1: Square, Triple and Cubic Lattices. By E. A. Cornish. Pp. 22. Bulletin No. 159: Poisonous and Harmful Fishes. By G. P. Whitley. (Division of Fisheries, Report No. 10.) Pp. 28+3 plates. Bulletin No. 161: A Review of the Evidence concerning Expansive Reaction between Aggregate and Cement in Concrete. By Dr. A. R. Alderman. Pp. 19. (Melbourne: Government Printer.) [178

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March 1943. Pp. 10. (Salisbury: Queen Victoria Memorial.) [178

Association of Scientific Workers of Southern Africa. Research Memorandum No. 1: Marine Biological Research and the South African Fishing Industry. By Wm. Edwyn Isaac. Pp. 16. (Cape Town: The African Bookman.) 1s. 6d. [178